Information Architecture for Irish Grocery Retailers using Business Intelligence Tools

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A dissertation submitted in partial fulfilment of the requirements of Dublin Institute of Technology for the degree of M.Sc. in Computing (Knowledge Management)

September 2007
I certify that this dissertation which I now submit for examination for the award of MSc in Computing (Knowledge Management), is entirely my own work and has not been taken from the work of others save and to the extent that such work has been cited and acknowledged within the text of my work.

This dissertation was prepared according to the regulations for postgraduate study of the Dublin Institute of Technology and has not been submitted in whole or part for an award in any other Institute or University.

The work reported on in this dissertation conforms to the principles and requirements of the Institute’s guidelines for ethics in research.

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1 ABSTRACT

Business Intelligence (BI) systems have a pivotal role to play in assisting retail management in the Irish grocery retail sector. The emergence of super chain stores and the increasing competition within this sector only increases their need for an effective and reliable Business Intelligence (BI) system. However despite this growing need Business Intelligence (BI) systems as they are currently deployed and used are not supplying the various levels of management with the necessary information they require to make effective retail management decisions. The information and reports received from Business Intelligence (BI) systems lack structure, are missing important pieces of information and do not provide a holistic view of the enterprise wide data. In particular the separation of data into separate pools prevents managers from getting the cross sectional view of the organisation necessary for effective decision making. The solution to the problem involves the use of information architectures. These information architectures allow the retail grocery organisations to examine their information sources, information flow processes and establish what management’s information requirements are. The use of an information architecture therefore enables a company to establish what it’s needs are from a Business Intelligence (BI) system independent of any particular technology. Therefore it can fit its Business Intelligence (BI) tools around its own unique processes and needs in order to successfully meet the needs of the various levels of management. This research presents the findings of a survey into the usage of Business Intelligence (BI) systems currently within the Irish grocery retail sector. The findings indicate that retail management are not getting the information and reports they require to make effective decisions. Building on these findings, and the learning gained from a literature view into the area, an information architecture was developed. The information architecture is presented from various different end user perspectives. This information architecture has a number of applications to grocery retailers such as providing a guide to retailers developing a Business Intelligence (BI) system from scratch or as a guide to retailers currently using Business Intelligence (BI) systems on how to maximise their return from it.

Key words: Business Intelligence, information architecture, Irish grocery retailers,
ACKNOWLEDGEMENTS

I would like to express my sincere thanks to my supervisor Brendan Tierney, whose valuable and enlightened insights and guidance was essential to the completion of this research project.

I would also like to offer my sincere thanks to my wife Nuala and children Ava and Brian for all their support.
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1. INTRODUCTION

‘‘...The information economy puts a premium on high quality actionable information – exactly what Business Intelligence (BI) tools like data warehousing, data mining, and OLAP can provide to the retailers...’’

Haigang (2005).

‘‘...Dispersion of information sources and decentralisation of the decision making process has resulted in the insufficiency of present information management tools. In this situation, organisations are offered the BI systems applications...’’


The term Business Intelligence (BI) was coined by Howard Dresner of the Gartner Group in 1989 to describe the various concepts and methods available to enhance the business decision making process through the use of information systems (Hashmi, 2004). The information systems referred to included executive information systems, decision support systems, enterprise information systems, management information systems, online analytical processing (OLAP), data mining, geographical information systems (GIS) and data visualisation. Chou & Tripuramallu (2006) noted that some of these enterprise systems have reporting and basic query functions, however organisational data by its nature is scattered in various business information systems. Therefore the isolated reporting functions of the different systems is insufficient in providing a company with an organisational wide view of business operations. This necessity for an organisational wide view of business processes is one of the key drivers of Business Intelligence (BI) systems. Olszak & Ziemba (2006) presents Business Intelligence (BI) systems as providing the holistic infrastructure necessary to support decision making in organisations.

The focus of this research project is on the applications of Business Intelligence (BI) tools to the Irish retail grocery sector. This sector of Irish retailing is very competitive and companies are looking towards Business Intelligence (BI) tools to provide them with competitive advantage over their market rivals (Chou & Tripuramallu, 2006) or perhaps it is now a competitive necessity. In contrast to the traditional reporting tools
such as spreadsheets, Business Intelligence (BI) systems are capable of providing a user friendly interface for examining multidimensional data sources. This provides the decision maker with access to actionable information in a timely manner thereby improving the decision making process. Business Intelligence (BI) tools can be used to answer various Customer Relationship Management (CRM) questions for example: (CRM2day.com, 2004)

- Who are your most valuable and least valuable customers?
- What factors affect the sale?
- How successful are promotional offers?
- Why are there variations between outlet’s profits in different geographical locations?

In addition to answering Customer relationship management (CRM) questions Business Intelligence (BI) tools also have various applications to Irish grocery retailers in other business functions (Haigang, 2005). For example Rasmussen et al., (2002) presents a case study of a company who were using Business Intelligence (BI) tools to extract actionable information from their various financial systems to answer questions such as:

- Sales order entry: sales by customer, sales by salesperson, sales by region, sales by outlet.
- General ledger: sales and profit by channel; actual various budgeted.

Business Intelligence (BI) tools play a pivotal role in enhancing the quality of the decision making process facing Irish grocery retailers. In particular it provides an organisational wide view of the data and facilitates querying across different business functions.

1.1 Research background

From the literature it is clear that there is no universal definition of Business Intelligence (BI) systems. However as observed by Negash (2004) they all refer to tools which are concerned with gathering and combining operational data with various analytical tools in order to provide managers with actionable information in a real time environment. Demand for BI technology is growing rapidly (Soejarto, 2003; Whiting, 2003). The use of the term Business Intelligence (BI) Systems refers to the set of related Business Intelligence (BI) tools working together to harvest information from
various different sources. The primary driver behind the increasing demand for Business Intelligence (BI) tools is the intense competition facing retailers. There are various applications of Business Intelligence (BI) tools to Irish grocery retailers particularly in the area of data warehousing and data mining. However there are no studies, to the knowledge of this author, concerned with assessing the relative success of these technologies in getting actionable information to retailers in the Irish context. These technologies must form part of an overall knowledge management system in order for the information to flow to all parts of the organisation. This point is particularly important with the advent of super chain-stores. In addition, retailers are faced with a bewildering array of Business Intelligence (BI) tools some of which they may not require or may not be suitable for their organisation.

The author of this dissertation has a number of years experience in the application of data mining techniques and has worked with a number of large retailers in developing their retail information management systems. From this experience it has become apparent that there is huge confusion among Irish grocery retailers about the capabilities of the different Business Intelligence (BI) tools and how to apply them. Despite the widespread usage of these Business Intelligence (BI) tools many retailers struggle to get the actionable information to their retail managers in a timely fashion. In addition retail management are frustrated with the information contained within reports. There is a clear need for a new approach to the development and utilisation of Business Intelligence (BI) systems with the Irish grocery retail sector.

1.2 Research problem

The aim of this research project was to create an information architecture, for Irish grocery retailers, for the use of Business Intelligence (BI) systems. Within the research literature there is no universally accepted definition of what an information architecture is. For the purposes of this research an information architecture is defined as a tool which provides an organisation with a mapping showing what data it captures, the location of this data and the uses and relationships between the data sources. It indicates to the Business Intelligence (BI) system where the data can be found and what data it needs to know in order to fulfil the information needs of the
various levels of retail management. This information architecture has a number of uses to Irish grocery retailers including the following:

- In the situation where grocery retailers are introducing Business Intelligence (BI) tools into a ‘green field site’ it will provide a blueprint to be followed in order to provide the total solution. In this situation it will provide:
  
  I. A tool to establish what the information needs of the various levels of management are.
  
  II. A tool for identifying the scope of the project. It will allow the retailer to establish what Business Intelligence (BI) tools are most suitable to fulfil their information needs.
  
  III. A common language to facilitate collaboration concerning the project in particular between technical and non-technical personnel.
  
  IV. A tool to educate and train business users at the various different management levels of retail organisations.

- For grocery retailers who are already using Business Intelligence (BI) tools it will provide an architecture which they can compare to their own particular design. This will be beneficial to grocery retailers who are attempting to maximise the information return from their Business Intelligence (BI) systems. In this situation it will provide a tool for gap analysis. It allows grocery retailers to compare their design and layout of Business Intelligence (BI) tools against the architecture to identify gaps.

- For academic purposes it will be useful as a teaching tool and also a source of further research. The information architecture can be used to provide students with an overview of the different Business Intelligence (BI) tools available to grocery retailers and how these tools interact with each other. It will also be useful to identify areas which warrant further research.

To create this information architecture it was necessary to perform a literature review into the area. This literature was broken into two areas; firstly a review was performed critiquing the various Business Intelligence (BI) tools available to grocery retailers, secondly a literature review was performed reviewing what the grocery retailer’s needs are from Business Intelligence (BI) systems. Additionally in order to create the information architecture it was necessary to perform primary research in the form of a survey which was used to evaluate the current use of Business Intelligence (BI) tools.
in Irish grocery retailers and determine what elements the different levels of retail management require in their reports. Babbie (1990) observed that the generic objective of all surveys used in research was to generalise from a sample to a population so that conclusions can be made. A survey was used for data collection because of the economy of design and the quick collection of data. The survey was cross sectional i.e. the data was collected at one point in time. The specific form of the survey was that of an administered questionnaire as described in the literature (Fink, 1995). The survey was administered over the telephone.

The targeted population for the study was retail managers in Irish grocery retailers. These retail managers were divided into two groups, firstly store and department managers and secondly regional and senior level managers. The sampling design for this population was a single stage due to the fact that the author has access to names in the population and has access to them. The sample was selected for the study using the approach highlighted by Babbie (1990) known as a non probability sample whereby respondents are chosen based on their convenience and availability. In all an attempt was made to contact and survey 100 retail managers with 66 of those contacted completing the survey. The survey data was analysed using Statistical Package for Social Science (SPSS) version 14.0.

1.3 Research objectives

The following objectives have been achieved throughout the dissertation and contributed to the overall outcome:

1. A literature review was performed critiquing the various different Business Intelligence (BI) tools available to grocery retailers in particular their different applications.
2. A literature review was also performed to investigate and establish the needs of Irish grocery retailers from Business Intelligence tools.
3. An evaluation of the current information reports received by retail managers was performed through the primary research. The reports were analysed in terms of its quality, accuracy, timeliness and relevance to retail management decision making process.
4. The elements that the different level of retail managers require in their information reports was also established through the analysis of the survey data.

5. An information architecture was developed for Business Intelligence (BI) systems. This information architecture was developed from the analysis of the survey data and learning gained from performing the literature review into the area.

6. An evaluation of the information architecture was performed through a structured interview with relevant parties.

### 1.4 Intellectual challenges

There were six intellectual challenges addressed in the process of completing this research. These challenges were addressed in the order below as the learning from one facilitated overcoming the next.

- Understand the capabilities, limitations and applications of the various different Business Intelligence (BI) tools currently available to Irish grocery retailers.
- Understand and identify the retailers need for Business Intelligence (BI) tools and their requirement from these tools.
- Understand how retailers are currently using Business Intelligence (BI) tools and how effective and appropriate the reports they extract from their systems are.
- Understand, establish and comprehend what the different levels of retail management reporting requirements are from Business Intelligence (BI) systems.
- Develop an information architecture for Business Intelligence (BI) systems then will enable them to effectively use their systems.
- Understand and integrate the feedback from the commercial personnel regarding the information architecture.
1.5 Research methodology

Both primary and secondary research was used during the creation of this dissertation. The secondary research took the form of an extensive literature review into the area of Business Intelligence (BI) tools. The literature review was broken into two areas:

- Review of the latest trends and developments in Business Intelligence (BI) tools and their possible applications to Irish grocery retailers.
- Review into the needs of grocery retailers which is creating the demand for Business Intelligence (BI) tools and what their requirements are from these tools.

Various different sources were used to complete the literature review including the following:

- Journals
- White papers
- Conference proceedings
- Newspapers
- Company websites.

The primary research used took the form of a survey which was administered to retail managers. The survey was used to establish the following:

- Highlight the weakness and information gaps experienced by retailers using Business Intelligence (BI) tools and therefore the need for retailers to use an information architecture.
- Evaluate the reports currently received by retail managers. This evaluation was based on a number of criteria including the following:
  - Timeliness
  - Relevance
  - Accuracy
  - Understand ability
- Establish the elements that grocery retailers at different level of the management require in Business Intelligence (BI) reports.

The knowledge gained through analysing the results of the surveys combined with that from the literature review was used to create the information architecture. A further element of primary research was then performed to evaluate the relevance and
accuracy of this information architecture to commercial organisations. This primary research was in the form of structured interviews. The information architecture was presented from different perspectives and also evaluated from these perspectives. A store manager, regional manager and information technology manager were therefore interviewed to establish their views regarding the information architecture.

1.6 Resources

The availability of various resources was crucial to the completion of this dissertation. The following is a list of these resources:

- Library facilities
  Access to Dublin Institute of Technology’s library facilities was essential for the completion of this dissertation particularly for the completion of the literature review. The ability to access library facilities from home also proved very useful.
- Computer with network access
  Availability of a computer with network access was essential as it provided access to various network printers and also provided a secure location to store the files. In addition to computer network access having the use of photocopying facilities was also useful.
- Microsoft Office Suite and Statistical Package for Social Science (SPSS).
  Having access to a computer which had the Microsoft office suite was crucial to the completion of the project. Also having access to Statistical Package for Social Science (SPSS) was important as it allowed for the analysis of the survey data. Both access to the Microsoft office suit and Statistical Package for Social Science (SPSS) was provided by the computer facilities in Dublin Institute of Technology.
- Internet access and email.
  The availability of internet access and usage of email facilitated the completion of this research project.
- Contacts with retail sector
  The author of this dissertation has a number of years experience working with different grocery retailers to improve the reporting capacity of this retail information management systems, in addition the author also has contact with a large number of retail managers through a continuous professional development degree programme in Dublin Institute of Technology. This proved very useful as
it provided easy access to a sample when performing the survey. Also it was useful because it meant the author had access to these individuals throughout the processes involved in this research.

- Guidance from supervisor

Regular contact with the project supervisor was a crucial importance in completing the research.

### 1.7 Project deliverables

The primary deliverable at the end of this research project is an information architecture for Business Intelligence (BI) tools. This information architecture is for companies in the Irish grocery retail sector. This research project also provides a set of guidelines to any retail company who are using Business Intelligence (BI) tools or considering introducing them to their organisation.

The deliverables at the end of this project will consist of the following:

- Critical review of all available Business Intelligence (BI) tools available to Irish grocery retailers.
- Critical review of the retailers need for Business Intelligence (BI) and possible applications of Business Intelligence (BI).
- Report on how well retailers are currently using Business Intelligence (BI) tools with regard to the information reports they extract from their system.
- Report on what retail managers require in the reports from their Business Intelligence (BI) systems.
- Description of information architecture showing each of the elements of the architecture and relationship between them.
- Commercial evaluation of the information architecture.

### 1.8 Scope and limitations

The aim of this research project was to create an information architecture, for Irish grocery retailers, for the use of Business Intelligence (BI) tools. This information architecture will ensure that grocery retailers gain the maximum return from their Business Intelligence (BI) systems. This research focused on the grocery retail sector however there are number of other retail sectors that are also using Business
Intelligence (BI) tools that would also benefit from the development of an information architecture. This is however beyond the scope of this research. The author intends to use this information architecture in his work with grocery retailers, however to assess its usefulness would require longitudinal research which is beyond the scope of this research project. The evaluation method involved presenting the information architecture to a relevant party and performing a structured interview. However to thoroughly evaluate the information architecture it would be necessary to introduce it into a retailer organisation and then evaluate its effects of the information extracted from the system.

1.9 Organisation of the dissertation

The major phases of the research project are shown in figure 1.1 and are directly related to the chapters in the dissertation. Chapter 2 of the dissertation presents the findings of the literature review into the different Business Intelligence (BI) tools available to Irish grocery retailers. This chapter focuses on the latest developments in each of the Business Intelligence (BI) tools considered in this research project and their applications to grocery retailers. The Business Intelligence (BI) tools reviewed are:

- Data warehousing
- Data mining
- Online analytical processing (OLAP)
- Geographic information systems (GIS)
- Visualisation technologies.

Chapter 3 of the dissertation presents the findings of the literature review into the needs of grocery retailers from Business Intelligence (BI) systems. It begins by discussing the various different drivers of Business Intelligence (BI) systems. It details each of the drivers individually and also describes the major overlap between the drivers. It then describes the different applications of Business Intelligence (BI) systems to Irish grocery retailers which focuses primarily on the customer relationship management (CRM) applications. The final section of this chapter details the concept of information architectures. This section begins by discussing the various different definitions of information architecture and ends presenting the definition used in this research.
Figure 1.1 Project phases (Author ((2007)).
Chapter 4 of the dissertation contains the analysis of the survey data into the usage of Business Intelligence (BI) tools in Irish grocery retailers. This chapter presents the findings to the various questions used in the survey. These findings provided the knowledge required to build the information architecture.

Chapter 5 presents the information architecture. This chapter is broken into a number of sections each of which present the information architecture from a particular perspective. The information architecture is presented from three different perspectives; store and department manager’s perspective, regional and senior management’s perspective and the integrated perspective which is intended for information technology personnel or technology confident business people.

Chapter 6 contains the evaluation of the information architecture. This chapter contains the findings of the structured interviews carried out with the relevant parties. The responses to the questions are summarised and noted in this chapter and a discussion of the findings are presented. Finally conclusions regarding the usefulness and accuracy of the information architecture are presented and discussed.

Chapter 7 is the final chapter of the dissertation and it contains the conclusions and recommendations formed after the completion of this research project.
2 BUSINESS INTELLIGENCE TOOLS

2.1 Introduction

Thomsen (2003) noted that the term Business Intelligence (BI) system has replaced decision support, executive information systems and management information systems. With each evolutionary step the systems have improved in terms of their capability to meet the enterprise’s need for computational and analytical queries (Power, 2004). Negash (2004) presents the following definition for Business Intelligence (BI):

‘BI systems combine data gathering, data storage, and knowledge management with analytical tools to present complex internal and competitive information to planners and decision makers.’

Fundamental to the idea of Business Intelligence (BI) is the concept of getting actionable information to managers in a timely fashion. Yet despite this clearly stated objective there is complete lack of research into the area of assessing how successful these systems have been at achieving this (Negash, 2004).

Langseth & Vivatrat (2003) produced a list of the essential components of proactive Business Intelligence (BI) systems which includes the following:

- Data warehousing, which is performed in real time
- Data mining capabilities
- Automatic detection of anomalies and exceptions
- Seamless follow-through workflow
- Geographic information systems (GIS)
- Data visualisation.

Business Intelligence systems play a pivotal role in assisting managers with strategic and operational decision making. Willen (2002) quoted a Gartner survey which ranked the strategic use of Business Intelligence systems as follows:

1. Corporate performance management
(2) Improving and maximising customer relationship management (CRM), monitoring business activity and providing the data necessary to support decision making.

(3) Specific Business Intelligence (BI) applications for targeted operations.

(4) Management reporting of Business Intelligence (BI).

The primary objective of using Business Intelligence (BI) systems in Irish grocery retailers is to support the making of various decisions on production, sales, competition monitoring and finance (Kalkota & Robinson, 1999).

2.2 Data warehousing

Bill Inmon coined the phrase “data warehouse” in 1992 and defined it as a managed database in which the data is:

1. Subject oriented: as distinct from application-oriented, i.e. data designed to aid in decision making. If a data warehouse is well designed it will provide a stable image of business processes, independent of legacy systems. For example it could be based around customers.

2. Integrated: the data warehouse consolidates application data from different legacy systems, usually operational databases which may use different coding and measurement units therefore cleansing and integrating is a key task. The pivotal operational system feeding the data warehouse for Irish grocery retailers is the electronic point of sales systems (ePOS). Another example of the sources of data which may be integrated into the data warehouse includes data from the loyalty card system.

3. Time-variant: all information in the data warehouse will have a time dimension i.e. each data point is associated with a point in time, and data points can be compared along that time axis unlike operational databases which only content up to date information. This inclusion of historical data provides the retailer with the ability to compare sales through time.

4. Non-volatile: old data is not replaced instead new data is always appended. The data warehouse will absorb new data, integrating it with the previous data (Inmon, 1992).
The primary reason that Irish grocery retailers have and are using data warehouses is to build a database (data warehouse) separately from transactional databases. This is due to the fact that analytic data and transactional data are different in terms of requirements and user communities. The data warehouse mainly stores detailed summarised data and metadata. Data within the data warehouse is typically aggregated to improve effectiveness of queries e.g. sales maybe aggregated by geographical dimensions or by time. The metadata contained within the data warehouse is concerned with facilitating the process of extracting, transforming and loading data from the various operational sources into the data warehouse (Forcht, 1999). Metadata is also concerned with automating the summarisation of data query management. The data warehouse provides an integrated data repository to assist retail managers in the decision making process.

In order for the data within the data warehouse to be of high quality the data from the operational databases must be effectively and efficiently placed into the data warehouse. ETL (Extraction-Transformation-Load) tools are concerned with getting the data from the various operational sources into the data warehouse (Olszak & Ziemba, 2006). Meyer (2001) divided ETL tools into four categories as follows:

- ETL tools that prefer specific types of input or output data and are reliable with fast functions of data processing and transforming;
- ETL tools that focus on extraction and loading of data;
- ETL tools that perform the process of data transformation quite well, although they do not offer servicing of many data formats;
- ETL tools that provide complex integration environments equipped with numerous solutions to assist users while constructing ETL systems.

Extraction of the data begins with getting access to the original data which is typically stored in various operational relational databases. The data from different operational sources will usually have differing formats and this greatly increases the complexity of the process. After extraction data is typically stored in a relational database which allows further data processing, this is known as a staging area. The extraction time, structure of source data and other details are typically recorded by the software which
extracts the data (Olszak & Ziemba, 2006). The next stage, transformation, is the most complex. During transformation a scripting language, typically SQL, performs data unification, aggregation calculation and identification of missing data. These processes will be performed according to a set of rules. The final stage involves loading the aggregated and filtered data into the data warehouse. Each retail organisation must decide upon the appropriate level of aggregation which meets their particular needs. It is important that retail management are responsible for making the decisions regarding the appropriate level of aggregation.

2.2.1 Advantages of data warehousing to retailers

The research literature presents various advantages of data warehousing which are summarized in the following section (Zeng et al., 2003; Lawyer et al., 2004).

1. Simplicity

Data warehousing simplifies business decision making by providing a single repository of data from which to generate a picture of the business. This picture of the business will include data from various sources that have been integrated into the data warehouse. Current operations can be monitored and compared with past operations, predictions of future operations can be rationally made and new business processes can be devised. Data warehouses typically store large amounts of historical data and corporate-wide data which companies need to turn into vital business information which they can base their decisions upon.

2. Better quality data.

Data warehousing improves the information that the various levels of managers receive in terms of consistency, accuracy, and documentation. The fact that the data is extracted transformed and loaded from the operational systems means that it should of high quality and provide a cross functional view of the organisation. The holistic view of data greatly improves the decision making ability of management.

3. Fast access.

Data warehouses allow users to retrieve necessary data by themselves in a timely fashion. Correctly designed and installed data warehouses are the foundation on which Business Intelligence (BI) systems are built. These
systems should allow the user to access up to date information though a user friendly interface.

4. Easy to use.
Queries from users do not interfere with operational systems, because a data warehouse enables easy access to business data without slowing down the operational database by taking operational data, aggregating it, and loading it into a separate data warehouse. The data warehouses focuses on subjects which conceptually makes it easier for retail mangers to understand. The data warehouse should have a user friendly interface which permits the business user to easily query the data warehouse.

5. Separation of decision-support operation from production operation.
Another advantage is that data warehouses are built in order to separate operational, continually updated transaction data from historical, more static data required for business analysis. By doing so, managers and analysts can use historical data for their decision-making activities without slowing down the operational systems. This separation also allows retail managers to store the historical data which is essential in retail decision making.

By using a data warehouse and thereby improving the management and utilisation of corporate knowledge, companies become more competitive, better understand customers, and more rapidly respond to dynamic customers. Therefore it could be argued that it is a source of competitive advantage. However the author of this dissertation is of the opinion that data warehousing similar to other Business Intelligence (BI) tools has now became a competitive necessity for Irish grocery retailers.

7. Information flow management.
The usage of data warehouses improves a retailer’s information management system. The data warehouses handles the large volumes of data from various operational data sources, and in so doing it manages the flow of information in addition to correlating the data. The use of a data warehouse ensures that all the data required by management in order to facilitate effective decision making can be located in one repository.

The users of data warehouses do not have direct access to the operational systems of the grocery retailer. This ensures the security of the operational systems is not compromised.

2.2.2 Conceptual design of a data warehouse

The primary concept of data warehousing is that the data stored for business analysis can most effectively be accessed by separating it from the data in the operational systems as displayed in figure 2.1.

Figure 2.1 Concepts of data warehousing (Laudon & Laudon ((2005)).

For data warehousing systems to be effective, as the foundation for Business Intelligence (BI) systems, data from various operational systems must be integrated into the data warehouse. In practice when integrating data from various sources it is easier to carry out the integration independent of the source applications. For grocery retailers the data warehouse must combine data from multiple source applications such as sales, marketing, finance, production and customer loyalty card system. Many large data warehouse architectures allow for the source applications to be integrated into the data warehouse incrementally (Chaudhuri et al., 1997).
The primary business reason for combining data from multiple source applications is to provide the capacity to cross-reference data from various business functions. All the data contained in a data warehouse should have a time tag. This is essential because data is never replaced in a data warehouse instead new data is appended. The data warehouse system can serve not only as an effective platform to merge data from multiple current applications; it can also integrate multiple versions of the same application. The data warehouse enables the retailer to perform year-on-year analysis even though the operational data concerned from historical years will no longer be contained in the operational systems (Han & Kamber, 2006).

The most important reason for separating data for business decision making from the operational data is the possibility of performance degradation on the operational system that can result from the analysis processes. The execution of complex queries could slow down the performance of operational databases (Han & Kamber, 2006). This is of particular importance in the retail context as without their primary operational systems, electronic of sales systems (ePOS), they could not perform transactions. The fact that the data in a data warehouse is non-volatile is another important characteristic. In effect this means that after the data has been loaded into the data warehouse, no modifications can be made to it.

In summary, the primary concept behind data warehousing is the separation of operational data from the data used for decision making. The operational data is aggregated and then loaded into a data warehouse which is completely separate from the operational databases. There are a number of business and technical issues that must be overcome in the data warehousing process.

2.2.3 Data warehouse architecture

From the literature there are two main types of architectures which may be chosen when designing a data warehouse. The first architecture is known as the ‘Bill Inmon’ architecture (Inmon et al., 1998) and the second is known as the ‘Ralph Kimball’ architecture (Kimball, 1996). Both architectures are similar in that they both secure raw data from legacy batch systems in addition to online operational systems and specialised operational data stores (ODS). However they fundamentally differ in how
they structure the data within the data warehouse. The Inmon architecture uses an atomic-level, third-normal form (3NF) relational structure in contrast to the Kimball architecture which uses a multidimensional structure. The most popular model for data warehouses is the multidimensional model which can exist in three different forms star schema, snowflake schema or a fact constellation schema (Armstrong, 2002; Chen, 1976; Kronenke, 2002; McFadden, 1999).

The most used architecture is the star configuration. An example of a star schema for a data warehouse in a retail organisation is shown in figure 2.2. The example is adapted from Han & Kamber (2006). There are two characteristics associated with the star schema for data warehouses:

1. They contain a central table, called a fact table, which contains the majority of the data, with no redundancy
2. They contain a number of smaller tables, called dimension tables that contain the data pertaining to each dimension.

The arrangement of the tables result in it resembling a star, hence the name star schema. The example shown in figure 2.2 for a retail organisation show sales with four associated dimensions. The dimensions used in this example are time, branch, item and location.

![Figure 2.2 Example of Star schema for data warehouse (Han & Kamber (2006)).](image)
The snowflake schema has many characteristics in common with the star schema. With the snowflake schema some of the dimensions tables are normalised resulting in the splitting of these tables into further tables. This results in a structure which resembles a snowflake as can be shown in the example of a snowflake schema shown in figure 2.3. Snowflake schema differs from the star schema in that the dimension tables may be all normalised to reduce redundancies.

![Figure 2.3 Example of snowflake schema for data warehousing (Han & Kamber (2006)).](image)

The fact constellation schema uses multiple fact tables to share dimensions tables. In reality is in truth a collection of star schemas hence it is sometimes called a galaxy schema. An example of the fact constellation schema is given in figure 2.4.

The designing, creating and implementing of a data warehouse is a complex procedure, consisting of the following activities as outlined by Chaudhuri, (1997):

- Decide upon the architecture of the data warehouse, select the storage servers, database and online analytical processing (OLAP) servers, and tools.
- Integration of the servers, storage medians and client tools.
- Decide upon and design the warehouse schema and appropriate views.
Define the physical warehouse organization, data placement, partitioning, and access methods.

Connect the data sources using gateways, ODBC drivers, or other wrappers.

Implementation of suitable designed scripts for data extraction, cleaning, transformation, load, and refresh.

Populate the data repository with the schema and view definitions, scripts, and the necessary metadata.

Decide what end-user applications to use, design and implement them.

Roll out the warehouse and its applications.

However the approach outlined by Chaudhuri (1997) focuses exclusively on the technical issues and does take into account a number of business issues that must be addressed in developing a data warehouse.

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Figure 2.4 Example of fact constellation schema for data warehousing (Han & Kamber (2006)).

### 2.3 Data mining

There are a number of different definitions of data mining in the literature (Ahmed, 2004; Fayyad and Uthurusamy, 2002; Hauke et al., 2003; Kantardzic, 2002; Poul et al., 2003). All definitions regarding data mining emphasise that it is concerned with
discovering various patterns, making generalisations or finding rules to describe data sources. Fayyad et al. (2002) defined data mining as;

‘..the identification of interesting structure in data. Structure designates patterns, statistical or predictive models of the data, and relationships among parts of the data.’

Each of the terms in the definitions, patterns, models and relationships, have concrete definitions. The term pattern refers to an identifiable trend or feature in the data or a subset of the data. A model is used to describe the data and anticipate future consumer behaviour. The final term relationship is concerned with the fact that there are connections and correlations between different pieces of data.

The three main uses of data mining to retailers are classified as follows (Haigang, 2005);

- Providing information to enhance the customer relationship management (CRM) functions in particular in the area of customer attraction and retention. If grocery retailers are to perform effective customer relationship management (CRM) they must be capable of extracting and understanding information and their customers.
- Identification of fraud. The use of data mining enables managers to identify any unusual trends which could possibly be an indicator of fraudulent activities.
- Identification of operational inefficiencies within and between retail outlets. The use of data mining provides the retailer with capacity to identify operational inefficiencies within the outlet in addition to comparing the performance of similar outlets in different locations. This can identify areas which senior must address.

Generally the information discovered from data mining is concerned with prediction or description of reality. Prediction endeavours to use historical data to forecast future customer behaviour whereas description attempts to describe and explain the action of customers. For example data mining customer’s purchases details can form the basis on a decision regarding future pricing policy (Moss & Alert, 2003; Reinschmidt & Francoise, 2001).
Data mining usually yields five types of information (Olszak & Ziemba, 2006):

1) Associations’ information.
   This type of information involves linking transactions around certain events. For example discovering that 65% of the time when a customer purchases milk they also purchase bread. The discovery of associations has number of applications to grocery retailers particularly in the area of store layout.

2) Sequences information.
   This type of information links transactions through time. For example discovering that 75% of the time after a customer purchases a new computer they purchase a new printer within one month.

3) Classification information.
   This type of information classifies customers into different groups. At the most basic level this could include classifications according to age and gender. Of more interest to retailers would be classifying customers into loyal and customers more likely to change retailers.

4) Clustering information.
   This form of information clusters customers around their likely customer behaviour. For example clustering customers into a group of who would be likely to respond to a certain promotion.

5) Forecasting information.
   This type of information is concerned with producing future sales figures based on patterns within the data. An example of forecasting would involve attempting to predict the likely impact of future price changes on the customers.

2.3.1 Data mining techniques

There are a number of different mining techniques available in the execution of data mining. The following is a brief review of the different techniques; each individual business problem or opportunity will be uniquely suited to one or more of the following techniques. The most commonly used techniques in data mining are: (Chan et al., 2002)

- Artificial neural networks: A range of conventional statistical methods can be applied such as cluster analysis, discriminate analysis, multiple regression,
logistic regression and time series forecasting. Multiple regressions for example, can be used to uncover a pattern of dependencies between multiple predictor fields and an outcome field, given a dependency does indeed exist

- **Decision trees**: Decision trees illustrate dependencies between data in the form of branches of a decision tree. The user can easily see how an outcome field changes with the different values of the predictor fields. Tree-based models are good at selecting important predictor fields and work well in situations where many predictor fields are partially irrelevant.

- **Genetic algorithms**: Optimisation techniques that use process such as genetic combination, mutation and natural selection in a design based on the concepts of evolution.

- **Nearest neighbour method**: Neural networks attempt to mimic the human brain in so much as they try and learn from the past experience “contained” within the data. Neural networks are key data mining tools when the object is more to do with predicting the future rather than explain the past.

- **Rule induction**: The extraction of useful if-then rules from data based on statistical significance.

- **Cluster Analysis**: This technique is perhaps the most common form of data mining and is used to identify associations among data points which represent events (data points) together. Most frequently used for “market basket” types of applications, linkage analysis can help point out associations such as when separate product purchases are related. Common examples in the grocery retail sector are beer and pretzels, yoghurt and skim milk, or wine and cheese.

### 2.2.6 Data mining techniques

There are a number of different data mining techniques available to retail organisations for the performance of data mining projects. The CRISP-DM (CRoss-Industry Standard Process for Data Mining) cycle was a cross industry project to create a technique for data mining projects which was industry and tool neutral ([http://www.crisp-dm.org](http://www.crisp-dm.org)). Another technique is the SAS SEMMA (Sample, Explore, Modify, Model, Assess) ([http://www.sas.com](http://www.sas.com)). The SEMMA technique is specific for SAS Business Intelligence (BI) software. The reality is that all the available techniques for performing data mining projects are very similar. Chan et al., (2002) outline the
following steps to form part of the data mining process which are demonstrated in figure 2.5. Each of these steps are also performed in the CRISP-DM and SAS SEMMA techniques although they may be called different names. Many retail organisations will have a hybrid technique for their data mining projects.

![Diagram of the data mining process]

**Figure 2.5 Stages in the data mining process (Chan et al., (2002)).**

1. **Problem Formulation.**
   
The first stage in the data mining process involves identifying the business problem/opportunity and areas where analysis of the data can provide extra-added value. Starting data manipulation and modelling without having a clear understanding of what the objective are is a common place problem. An example for grocery retailers would be determining what products to place on promotion in order to attract high value customers. This first step is performed by the business person.

2. **Data Preparation.**
   
The second stage involves all of necessary pre-processing manipulation of the data in order to select the databases (data consolidation), to understand the data, to clean the data, to enrich the data (data availability and consistency) and to ensure that the coding is uniform between the different database sources. If the retailer has a data warehouse in operation this step will only involve selecting the appropriate data.
3. Modelling and Assessment.
   The third stage is principally undertaken by the data miner. Modelling starts with translating the specific question(s) into techniques to use. In general, different techniques can be used to solve the same problem.

   The final stage of the cycle involves the model deployment, to the transposition of the model into the production system. Additional difficulties may be encountered in the production system such as the integration of the results into another process, the dynamic character of the data, the huge volume of data and the fact that production data is stored in different formats.

Data Mining is not a simple process and there is no tool that can do the job automatically. Tools can aid data mining, but it requires both human analyst expertise and business expertise. Business expertise is necessary to identify the business problems that the analyst has to focus on. The final analysis that translates the results into business actions may also reside with the business analyst. Finally they can also provide feedback to further improve the analysis (Han & Kamber, 2006).

2.2.7 Retail companies using Data mining

Most of the large retailers are using data mining to discover information about their customers (Ahmed, 2004). Examples of companies using data mining techniques include MasterCard who in addition to data mining the transaction of its customers also sell the details to other companies. Wal-Mart is considered to the pioneers of data mining and data management. Wal-Mart information management system gathers electronic point of sale data from over 2,900 outlets in six different countries. This data is then loaded in a data warehouse which is 7.5 terabyte in size. Wal-Marts suppliers can then access the data on products and perform various data analysis. The suppliers use this data to extract customer-buying patterns at each outlet. This extracted information forms the basis of decisions regarding the store inventory and merchandising issues (Spinello, 1997). Many retailers attempt to complement customers’ electronic point of sales (ePOS) data with external sources of information such as postal address to do market basket analysis. Practically every retailer records the details of each electronic point of sales (ePOS) transaction for stock management.
purposes and information extraction. For example Home Depot combines electronic point of sales (ePOS) data with postal code information for each customer. Additionally in situation where loyalty are not used the cashier may enter the sex and appropriate age range of the customer into the cash register (Branscomb, 1994). Loyalty cards and credit card numbers are widely used in the retail industry to record and track customers. Background information (age, gender, address, martial status) is combined with transaction data in what is known as, market basket analysis.

2.4 Online Analytical Processing (OLAP)

The term on-line analytical processing (OLAP) was coined by Codd (1993) to describe the set of tools that can analyse data to reflect actual business needs. Twelve rules were listed that described online analytical processing (OLAP) (Codd, 1993):

1. Multidimensional views
2. Easily accessible
3. Transparency
4. Consistent reporting
5. Use of client/server architecture
6. Generic dimensionality
7. Dynamic sparse matrix handling
8. Multi use support
9. Cross-dimensional operations
10. Intuitive data manipulation
11. Flexibility in reporting
12. Unlimited levels of dimensions and aggregation.

Online analytical processing (OLAP) facilitates the modelling of complex data sources in multidimensional terms and allows the following operations: (Chaudhuri & Dayal, 1997).

- Rollup. This online analytical processing (OLAP) operation is also called drill-up. Rollup involves increasing the level of aggregation of the data. For example consider a data cube concerning sales which contains two dimensions, location and time. The roll up operation could be used to incorporate more locations thereby increasing the volume of data.
Drill-down. This online analytical processing (OLAP) operation involves decreasing the level of aggregation thereby increasing the detail. Drill-down is the opposite of rollup. Drill down can be performed by adding more dimensions to the data cube.

Slice and dice. This online analytical processing (OLAP) operation allows selection and projection of certain elements of data.

Pivot. This online analytical processing (OLAP) operation, which is also known as rotate, is a visualisation technique that rotates data to present it from different views. It is usually performed to make the data more understandable for management.

The multi-dimensional data model which is the underlying concept of online analytical processing (OLAP) influences the query engines which can be used. The multidimensional data model assigns a set of numeric measures that are the objects which are to be analysed. For example in a retail context the objects of measurement could be sales, budget, revenue, inventory and ROI (return on investment). Each one of these numeric measures is dependent upon a number of different dimensions, which provide the situation for the measure. Therefore dimensions associated with a sale amount could be the city, product name, date of the sale transaction and salesperson. The dimensions grouped together are the factors that uniquely determine the measure. Therefore the multidimensional concept views data as a measure of the multidimensional space of dimensions which is the basis of the data cube (Chaudhuri & Dayal, 1997).

2.5 Geographic Information Systems (GIS)

Since the 1990’s retail organisations have adopted Geographic information systems (GIS) for decision making purposes (Murad, 2005). A Geographic information system (GIS) is an Information Technology based system that enables the capturing, modelling, storing, retrieving, checking, integrating, analysing and displaying of geographically referenced data by digitised maps. Negash (2004) defined GIS as:

‘Software packages that are capable of linking databases with electronic maps.’
Langston et al., (1997) used Geographic information systems to determine the regional market shares of three British based grocery retailers, Sainsbury, Kwik and Asda. In addition to collecting, storing, retrieving and presenting spatial data Geographic information systems (GIS) are used to identify locations which meet certain criteria, explore and explain cross relations between data sets, evaluating alternatives to assist in decision making and displaying selected environments in both a visual and numerical terms. In effect they provide spatial analysis which allows the presentation of two and three dimensional data. For example retailers performing market analysis could overlay customer locations, school locations and existing competition in order to make a decision about a site location for a new outlet.

2.5.1 GIS and OLAP

Andrienko et al., (2003) noted that Geographic information systems (GIS) software applications offer a thematic mapping tool which provides an interactive visualisation and exploration of spatiotemporal data. The particular Geographic information systems (GIS) software considered was CommonGIS which uses a number of different methods to provide dynamic classification, interactive charts, multi-criteria decision support, data mining, and time series analysis. For Geographic information systems (GIS) software to be successful it must offer direct manipulation of the user interface, in contrast to selecting from lengthy menus the user should be presented with icons to manipulate the interface. Data warehouses combined with online analytical processing (OLAP) technology can present large amounts of data in a format suitable for fast analysis and therefore can be an important instrument for providing business decision support (Zeng et al., 2003). Voss et al., (2004) observed that for Geographic Information Systems (GIS) to be considered as a useful Business Intelligence (BI) application it must have a connection to data warehouses and online analytical processing (OLAP) capabilities. Andrienko et al. (2003) is in agreement and suggests that combining the visual and analytical capabilities of Geographic Information Systems (GIS) with an interface to data mining tools makes Geographic Information Systems (GIS) an extremely useful tool for retail decision making.
Voss et al., (2004) used the following example which is directly applicable to Irish grocery retailers which links Geographic information systems (GIS) and online analytical processing (OLAP) from a data warehouse. The objective was to analyse the sales data from a retail organisation which has 30 outlets and evaluate the following:

- Locations for new outlets.
- Trends in the sales data of the existing outlets and explain these trends by reference to the local environment.

The analysis combines the company’s business data and relevant socio-economic data concerning outlets. The business data was held in a data warehouse. The pieces of data recorded are measures of sales figures, sales counts, and fixed costs. The dimensions involved are hierarchical:

- Locations: (10 districts with 30 outlets)
- Time: (year, month, day, hour)
- Stock: (15 product groups, with approximately 500 products)

The measures were recorded as:

- Sales figures recording location, time and stock.
- Sales counts recording location, time and stock.
- Fixed costs recording location, year and month.

The above was stored in two online analytical processing (OLAP) cubes, one cube with hourly sales figures and counts and a second cube with monthly fixed costs. The measures were aggregated in various different ways to facilitate the analysis and evaluate of sales data in the following ways;

(a) From outlets to districts
(b) From products to product groups
(c) From hours to days and months.

Each outlet’s weekly profit was recorded for the purpose of classification and ranking. Figures 2.6 and 2.7 are two examples of instruments extracted from the system for retail managers to assist them in the analysis of the performance of different outlets.
Figure 2.6 Example of combined GIS and OLAP data (Voss et al., (2004)).

Figure 2.7 Combined GIS and OLAP data (Voss et al., (2004)).

Figure 2.6 is an example of an instrument produced to support retail decision making which combines online analytical processing (OLAP) and geographic information
system (GIS) data. It shows a sequence of bars for each retail outlet. The bar represents the sales count for each of the different type of product group in this particular month. The same data is also contained in the charts for a time period of 13 months. This chart shows for each product group the sales count for each retail outlet. This allows senior management to directly compare the performance of different retail outlets.

Figure 2.7 is also an example of combined online analytical processing (OLAP) and geographic information system (GIS) data which the same data as the above example except in this case it also includes a grid of cells. The colours of these are an indicator of a ranking system in operation which takes into account various pieces of socio-economic data which are given different weightings (Jankowski et al., 2003). This data can then be used to explain the performance of different retail outlets. In the example used a matrix with four fields was developed to distinguish four classes of retail outlets within this particular chain. These were retail outlets with high/low counts at good/bad locations. The colours of the classes are applied to the outlets in the map.

2.6 Visualisation

Data visualisation refers to the various technologies available to present and view data once it has been processed. Unlike geographic information system (GIS) data, which represents physical spaces, the data represented by data visualisation usually represents abstract objects such as profit, sales or cost. Since the data is abstract it is useful to create a visual artefact. These visual artefacts go far beyond pie and bar charts offered by Microsoft excel (Tegarten, 1999). However Microsoft excel is still widely used as a data visualisation tool in the Irish grocery retail sector. Modern data visualisation techniques can present data using digital images, geographic information systems, graphical user interfaces, multidimensional tables and graphs, virtual reality, three dimensional presentations, videos and animation (Li et al., 2001). Visualisation techniques exploits the human visual capabilities to interpret and extract information from data and provides an overview of complex data stores (Negash, 2004). Bates (2003) observed that effective visual analysis technologies will allow self guided exploration and visual analysis of large amounts of data. Most retail data visualisation applications are dealing with large databases with many fields and possibly millions of rows these makes the interactive visualization of these databases essential (Cox, 2006).
Visualisation techniques in use today in the retail industry usually involve the use of advanced dashboards which can present large amounts of complex data on a single screen. The results of analysis for Business Intelligence (BI) systems will typically have several dimensions e.g. senior management may want to analyse sales figures by territory, by sales person, by product, by outlet or by time. This example would result in data which has five dimensions and it is essential to have the technology to allow the user to change/add dimensions easily. This is known as slicing and dicing the data and is a common feature of most online analytical processing (OLAP) tools. Turban et al. (2006) state that the following three factors are essential to multidimensionality:

1. Dimensions e.g. products, outlets, salesperson, country
2. Measures e.g. money, sales volume, costs
3. Time e.g. daily, weekly, monthly or annually.

The need to view multidimensional data is one of the key drivers behind the improvements in data visualisation technologies (Campbell, 2001).

2.7 Conclusion

This chapter of the dissertation provided a literature review of the various Business Intelligence (BI) tools available to Irish grocery retailers. The various applications of these Business Intelligence (BI) tools were discussed. The Business Intelligence (BI) tools considered were:

- Data warehousing.
- Data mining.
- Online analytical processing (OLAP).
- Geographic Information System.
- Data visualisation.

Individual grocery retailers will typically have a combination of these Business Intelligence (BI) tools which will interact with each other to form their Business Intelligence (BI) system. In addition these tools will interact with the existing information technology infrastructure. However Business Intelligence (BI) systems are also concerned with understanding the unique information landscape of their organisation. In order for grocery retailers to effectively develop and use Business Intelligence (BI) systems they must have a clear understanding of their own
information landscape. The use of an information architecture can assist grocery retailers in getting Business Intelligence (BI) system to fulfil their potential. The information architecture allow retailers to establish what data they capture, where they store it, how the data flows through the organisation, what are the relationships between the different sources of data and what information do the various levels of management require.
3 ANALYSIS OF THE NEEDS OF RETAILERS DRIVING BUSINESS INTELLIGENCE

3.1 Introduction

This chapter of the dissertation analyses the various needs of grocery retailers from Business Intelligence (BI) systems. The chapter is broken into four sections. The first section examines the various different drivers of Business Intelligence (BI) systems. The second section discusses the different applications to grocery retailer of Business Intelligence (BI) systems. The third section describes what is meant by the term information architecture and describes how it may be used to assist in utilisation of Business Intelligence (BI) systems and thus improve the retail decision making process. The fourth section presents the conclusion formed from the completion of this literature review.

3.2 Drivers of Business Intelligence (BI) systems

There are a number of drivers of Business Intelligence (BI) systems in the Irish retail grocery sector which are presented in figure 3.1. The major drivers of Business Intelligence (BI) are dealt with individually but it is important to note that there is considerable overlap between each of these drivers. For example the advent of super chain stores make management more difficult and requires that management use Business Intelligence (BI) systems to monitor, control and make effective decisions. The advent of super chain stores also increases the competition within the Irish grocery retail sector thereby also creating a need for management to be using Business Intelligence (BI) systems. Large grocery retailers now consider Business Intelligence (BI) to be a competitive necessity in order to make effective management decisions. The four main drivers dealt with in this section are;

- Customer relationship management (CRM)
- Intense Competition in the retail grocery sector
- Advent of Super Chain stores
- Business Performance Management (BPM)
In addition to each of these individual factors driving the retailers need for Business Intelligence (BI) systems there is also considerable overlap between the factors.

3.2.1 Customer Relationship Management the primary driver of Business Intelligence Systems.

Various definitions of Customer relationship management (CRM) exist within the literature with Greenberg (2002) defining customer relationship management as follows:

‘..all the enterprise wide efforts involved in the attracting, retaining and enhancing customers..’

Central to the idea of customer relationship management (CRM) is the philosophy that customers are at the core of a business and that a company’s survival and future growth are dependent upon managing relationships with its customers and meeting their needs. Customer relationship management (CRM) is one the primary drivers behind the use of Business Intelligence (BI) tools in the Irish grocery retail sector. If retailers are to meet the needs and expectations of their customers then they must first
be capable of establishing what the needs are, hence the need for Business Intelligence (BI) systems. Retailers are now realising that the retention of existing customers is equally as important as attracting new customers, both of which can be improved upon by the usage of Business Intelligence (BI) tools (Haigang, 2005). Fjermestead and Romano (2003) suggest that the main objective of customer relationship management (CRM) is to build long term sustainable relationships with its customers. Even the briefest review of literature into the area will uncover various definitions of customer relationship management (CRM). The major reason for this is that customer relationship management (CRM) is a multidisciplinary area borrowing ideas from marketing, management, behavioural science and information technology. The Patricia Seybold group has distinguished three types of customer relationship management (CRM) according to the tools used by the customer relationship management (CRM) applications. These are:

1. Customer facing
2. Customer touching

Figure 3.2 highlights the major Customer relationship management (CRM) application areas and the various tools associated with each area.

The Customer relationship management (CRM) tools around customer facing applications endeavour to ensure a high level of service to customers in all interactions with the organization. Areas covered here will include helpdesk and sales force automation. In order to achieve effective customer facing customer relationship management (CRM) the various tools must ensure the flow of information throughout the organisation. The second form is the customer relationship management (CRM) tools involved in customer touching. This tools deal with all the applications that the customers interact with. This form of customer relationship management (CRM) is particularly important to the e-commerce.

The third form of customer relationship management (CRM) is known as customer-centric intelligence applications. The primary purpose of these applications is to analyze the vast quantities of data from operational sources and interpret and present the results to improve customer relationship management (CRM). This third form of
Customer relationship management (CRM) is dependent upon Business Intelligence (BI) systems and this form of Customer relationship management (CRM) is of critical importance to Irish grocery retailers.

**Figure 3.2 CRM Applications (Seybold Group (2002)).**

Similar to the Patricia Seybold group Haigang (2005) identified two forms of customer relationship management (CRM). These are:

1. **Operational customer relationship management (CRM).**
   
   This form is primarily concerned with information flow management and sale force automation.

2. **Analytical customer relationship management (CRM).**

   This form involves the sophisticated analysis of the data from operational databases and various other sources, for example electronic point of sale (ePOS) data and loyalty card data. It is the retailers need to perform analytical customer relationship management (CRM) which is driving the development of Business Intelligence (BI) tools. The performance of analytical customer relationship management (CRM) gives the retailer access to the mind of the customer; and therefore the ability to develop one-to-one relationship with the
customer, design marketing and promotion campaigns and optimise store-layout.

3.2.2 Business Performance Management (BPM)

The second identified driver of Business Intelligence (BI) systems in the Irish grocery retail sector is Business performance management (BPM). Golfarelli (2004) observed that in the last number of years the approach to business management has changed, with managers now understanding the importance of ensuring the enforcement of achieving the goals defined by their strategy through metrics-driven management. The traditional approach to Business Intelligence (BI) supports the bottom-up extraction of information from raw data; however this approach fails in top-down enforcement of the company strategy. To address these issues a new approach to Business Intelligence (BI), called Business performance management (BPM), has emerged (Golfarelli, 2004). This adoption of the Business performance management (BPM) approach to retail management demands that retailers must be using Business Intelligence (BI) tools.

Central to Business performance management (BPM) is the use of a data warehouse coupled with a reactive element which is capable of monitoring the time-critical and business critical operational processes, thereby alerting tactical and operational managers to any issues that require action in order to ensure organisational actions match the overall company strategy (Golfarelli et al., 2004). In an attempt to reduce costs and meet customer’s expectations retailers have become process-oriented and are adopting an end-to-end strategy in an attempt to synchronize all the business activities (Baina et al., 2003). Simultaneously retail companies have began emphasising the achievement of the goals set out in their strategy through metrics-driven management (Sveiby, 1997). Therefore managers need to have the capability of continuously measuring their performance through what is termed key performance indicators (KPI) (Kaplan, 1992). Each retail organisation must decide upon its own set of key performances indicators (KPI) and communicate these at all the company levels. The Business Intelligence (BI) system then monitors operations and reports back how the organisation is performing in terms of its key performance indicators (KPI). A well designed and operated Business Intelligence (BI) system will highlight any significant
deviations from key performance indicators (KPI) in a timely fashion to afford retail management the opportunity to take corrective action.

Clearly the Business Performance Management (BPM) approach to managing retail organisations has fuelled the need for Business Intelligence (BI) systems. Golfarelli (2004) suggests that the use of Business Intelligence (BI) for this purpose requires a slight reorientation in how it is used. In particular it affects the data type collected, method of data extraction and distribution and the frequency and accuracy of the data collected. The data warehousing approach provides assistance to managers in understanding their companies by providing bottom-up extraction of knowledge from data but this approach does not facilitate the enforcement of the retailers’ strategy in a top-down fashion (Golfarelli et al., 2004).

3.2.3 Emergence of superstores and increased competition.

The last two drivers which are increasing the retailer’s need for Business Intelligence (BI) systems are taken together as they are intrinsically linked. The emergence of superchain stores and the resultant increase in competition between Irish grocery retailers. The last number of years has witnessed the rapid growth in the 'chain of superstores' throughout Europe. Coupled with this there has been a trend towards consolidation and globalization in the retail grocery industry. This has resulted in an increase in the bargaining power of the retailer in the supply chain. Haigang (2005) suggests that retailers will continue to expand globally in an attempt to counteract the saturated domestic markets and increasing competition. Examples of this include Wal-Mart who acquired Britain's third largest supermarket chain ASDA in order to establish itself in Europe. The emergence of these superstores has had two effects which increases the retailer’s need for Business Intelligence (BI) system:

- These superstores have greatly increased the competition in the sector. This has resulted in an increase in pressure on the retailer to meet its customer’s needs and expectations in order to retain customers and attract new customers. In order to do this it must use Business Intelligence (BI) tools to gain an understanding of its customers and therefore be capable of fulfilling their needs and expectations.
The large number of customers and staff means that no relationship develops between the customer and the retailer. This makes the performance of the old style of Customer relationship management (CRM) difficult if not impossible. In these circumstances retailers must employ Business Intelligence (BI) tools in order to fully understand their customers.

In addition to the above factors the emergence of the chain of superstores also creates a further problem for retail management with regard to the decision making process. The scope of many decisions in these organisations are regional and in many cases maybe global. To make effective decisions in these circumstances requires a wide exchange of information and knowledge sharing, and activities must be effectively coordinated and managed (Viehland, 2005). To meet the decision making needs of management in these circumstances requires the use of Business Intelligence (BI) systems (Gray, 2003; Liautaud & Hammond, 2002; Olszak & Ziemba, 2004; Turban & Aronson, 1998).

The emergence of super chain stores also creates a need for Business Intelligence (BI) systems due to its supply chain management. Many of these retailers have set up distribution networks to handle their inbound logistics. Haigang (2005) argues that in order to succeed in this area retailers need the ability to harness worldwide distribution and logistics networks for purchasing. The purpose of having access to this global supply chain is to ensure that high levels of products are available and that these are the products that the consumers want to buy. In order to ensure that they are sourcing products that consumers want to buy retailers must use Business Intelligence (BI) tools to understand their customers.

3.3 Applications of Business Intelligence Tools to decision making process in Irish Grocery Retailers.

The primary application of Business Intelligence (BI) to Irish grocery retailers is in the area of customer relationship management (CRM). The overall purpose of Business Intelligence (BI) in this area is to provide an insight into their customer’s behaviour and their needs and expectations. This is achieved by facilitating the querying of large volumes of data to identify trends and attitudes. However Business Intelligence (BI) is
now also being used to extract information to assist retailers in other retail functions such as store operation, supply chain management and store front operations (Han et al., 2006). Figure 3.3 shows the major application areas of Business Intelligence (BI) tools to Irish retailers however the focus of this research is primarily in the area of customer relationship management (CRM). The purpose of the overlapping circles is to indicate that the applications overlap enabling users to cross tab between functional areas. This ability to cross tab information is very important especially to super chain stores to enable managers get a holistic cross function view of what happening in a particular retail outlet. Traditionally retailer had separate islands of information which made the establishment of a holistic picture of the organisation a difficult and time consuming task. This section reviews the various applications of Business Intelligence (BI) tools to Irish grocery retailers in terms of Customer relationship management (CRM).

![Figure 3.3 Application areas of Business Intelligence (BI) tools for retail organisations (Author, 2007).](image)

### 3.3.1 Customer relationship management (CRM) applications

Haigang (2005) identified seven applications of Business Intelligence (BI) into the area of Customer relationship management (CRM) for retail organisations. The seven applications are as follows:

1. Customer Lifetime Value.
Not all customers are equally profitable. Business Intelligence (BI) tools can be used to evaluate a customer’s lifetime value to the retail organisation. This is particularly important to banking organisations.

2. Customer loyalty analysis.
This Business Intelligence (BI) application allows retailers to evaluate how loyal customers are likely to be. Retailers are now aware that it is cheaper to retain customers rather than attract new ones. To promote loyalty among customers, a company must understand the reason for customer dissatisfaction. This is important to Irish grocery retailers in light of intense competition within their environment.

3. Customer segmentation.
This involves dividing the customers into groups of segments according to the various different attributes. This can often provide insights into how different segments of customers may react for example to price changes. Grocery retailers would find it useful to divide customers according to their age and gender and then attempt to predict how different segments behave. For example what gender and age group are likely to respond to a particular promotion. Customers can also be divided according to their socioeconomic background.

4. Promotion analysis.
This Business Intelligence (BI) application can be used to evaluate the effectiveness of promotional campaigns. The results of this analysis can then be used to decide upon the design of future campaigns e.g. perform analysis to evaluate if overall sales improved while certain products were on promotion or just the promotional product. Most grocery retailers now attempt to place the products that their most valuable customers are interested in on promotion.

5. Product pricing and merchandising.
Perhaps the most important decision facing all retailers concerns setting the product price. The use of analytic customer relationship management (CRM) can assist the retail organisation develop prices models for different products. Also Business Intelligence (BI) systems can assist retail management in making decisions about merchandising. Planning the correct merchandise is a critical decision facing retailers. Selecting the correct merchandise depends upon having a good understanding of your customers.

Through the use of analytical customer relationship management (CRM) retailers can identify customers whom they may cross sell products to. Business Intelligence (BI) tools can analyse products purchased by customers to ‘up sell’ move profitable products to customers at the time of contact.

7. Target Marketing.

The use of analytical customer relationship management (CRM) allows retailers to target customers which are likely to response to certain promotional campaigns. This is particular important to grocery retailers as once it has established who its most valuable customers are it most target its promotional offers towards this customer segment.

3.4 Retailers requirements from an Information architecture

3.4.1 What is an information architecture?

There are a number of conflicting definitions of the term information architecture in the research literature. Laudon & Laudon (2002) described an information architecture as the particular design that the information technology tools take in an organisation in order to achieve its selected goals. Therefore applying this definition to Business Intelligence (BI) tools and the retail sector the purpose of an information architecture is provide a blueprint of the design that Business Intelligence (BI) tools should take in an organisation in order to enable the extraction of the actionable information required for decision making. Once a company has designed its information architecture it can design its information technology infrastructure in order to achieve their selected goals. This definition implies that information architectures are concerned with the technical details of information technology systems. The fact that information architecture is intended to meet the information needs of users in various functions and at different levels of the organisation greatly increases its complexity (Kalakot and Robinson, 2001). Laudon & Laudon (2002) concept of an information architecture is direct contradiction to that presented by Sherman (2003).

Sherman (2003) described an information architecture as providing business with the knowledge to know what business application systems to access in order to locate and extract the information necessary to support decision making. Sherman (2003) also
noted that the information architecture is the only aspect of a Business Intelligence (BI) system that business users interact with. Their perspective on Business Intelligence (BI) systems is that the other parts are just part of the infrastructure and they do not concern them. Many retail organisations have made the error of viewing the deployment of Business Intelligence (BI) systems in similar terms to the deployment of any other technology. The SAS institute (2007) concluded that companies require an in-depth strategic approach to designing, rolling out, managing, tracking and supporting Business Intelligence (BI) systems. Furthermore if companies approach them as simply another technology deployment they will not deliver the information management require for decision making. In order for retailers to ensure the successful deployment of Business Intelligence (BI) systems retailers need to have an in–depth strategic approach to designing, rolling out, managing and using Business Intelligence (BI) systems. A primary component of this approach involves the development of an information architecture.

The author of this dissertation defines an information architecture as a tool which provides a mapping showing what data an organisation captures, the various locations of this data, the relationships between the various sources of data and how the data flows through the organisation. This definition of an information architecture is in broad agreement with that of Sherman (2003). It indicates to the Business Intelligence (BI) system where the information can be found what information it needs to know and what the information will be used for. By first developing an information architecture retailers gain an in depth understanding of the information they hold, how it is captured and processed and how it flows throughout the organisation. The use of information architectures provides a top down approach to developing Business Intelligence (BI) system to fulfil these needs. This approach is in contrast to the bottom up approach which begins with the different Business Intelligence (BI) tools and in effect attempts to get the information needs of the organisation to fit around the Business Intelligence (BI) tools.

The problem facing Irish grocery retailers is the huge volume of data and vast array of different Business Intelligence (BI) tools offering various functionalities. Paradoxically poorly designed and deployed Business Intelligence (BI) systems can further inflame this problem. The challenge is to develop Business Intelligence (BI) systems that
provide retail managers with the information they require in a timely fashion. The use of information architectures establishes a common language for communicating between business and IT personnel. It ensures the use of a common language and terminology.

3.4.2. Information architecture evolution

The concept of information architecture has evolved over the past 20 years. In the 1980s the architectural approach to managing information systems developed in response to the increasing complexity and size and importance of these systems. In contrast to the project based approach for standalone information systems the architectural approach was broader in scope and took into consideration organisational impacts and processes (Nolan et al., 1987). Zachman (1987) observed that the use of an information architecture approach created an instrument that was used:

“…for defining and controlling the interfaces and integration of all of the components of the system....”

Everden & Everden (2003) noted that with the more extensive links between systems, and organisations reliance on their systems, the concept of an information architecture is more relevant today. This is particularly true in the case of organisations that are using Enterprise resource planning (ERP). The information architecture approach focuses on information, followed by technology, therefore clearing making the point that the use and value of information is what provides the competitive resource not the systems supporting its use. This latter point is particularly relevant when considering the application of Business Intelligence (BI) systems to retail organisations. Retail managers are not concerned with the underlying systems but they are concerned with having access to appropriate and accurate information a timely fashion on which to base their decisions.

Everden & Everden (2003) identified three distinct phases in the evolution of Information architectures, as shown in figure 3.4.
The first phase was concerned with the development of standalone information systems, the second phase was concerned with developing information systems which operated across the enterprise and the most current phases is concerned with focusing on the information rather then the technology. During the 1990s the idea of knowledge management being a key business function and the availability of actionable information being essential for effective decision making began to dominant manager’s needs from information systems. This triggered the development of the third phase of information architectures which reflected the need for the separation of the technology and information architectures. The distinction between technology and information architectures allowed information architects to understand user requirements. Therefore ensuring user requirements were meet in addition to ensuring that the information architecture is not ignored and the return on investment is enhanced.

3.4.3 Developing an information architecture

Everden & Everden (2003) outline the following process for developing an information architecture:

1. Establish the information management requirements.

The primary objective of the first step is to clearly establish what information needs to be collected and extracted and who needs to receive the information and
in what timeframe. Establishing the correct processes for information management is quite complex. Information itself is complex, therefore any architecture describing it is likely also to be complex. A single diagram describing an information architecture suggests that the architecture is at best two-dimensional, whereas the reality for most organisations is that its organisational needs are at best complex with at least four or five dimensions. Establishing the information management requirements begins by being absolutely unambiguous about the organisations need to improve the management, flow and use of its information and what is the deliverable at the end. At the end of this first step the following should be clear the principles, information design guidelines, standards and naming conventions. Another important goal of the architecture is establish the dimensions. The principles and rationale used in creating the architecture need to be clear and communicated to allow user to understand the architecture.

2. Creating a management toolkit.

Once the first step is completed and the requirements have been determined it will become apparent what tools are needed in order to fulfil these requirements. The information architecture will allow users select the most appropriate Business Intelligence (BI) tool. To address the information needs of all users the architecture must be capable of being viewed from different viewpoints and each of these different perspective will have a different level of detail.

3. Defining an information map.

The purpose of the information map is to graphically display the location of all the relevant information items, the relationship between them and how the information flows between different items. It must describe and address the necessary metadata. The information map will outline the following:

- Describe who uses the information
- How it could be used
- How it is structured
- Why it is structured in that particular way

In practice each organisation will have a unique information map which will be complex and its creation requires an in-depth understanding of all the organisational processes. Current trends in information mapping involve the production of multidimensional architectures which include the formal
representation of generic business and organisational information. The information maps themselves are targeted at business users and avoid technical jargon.

4. Using the information resource.

Information architectures are by their nature dynamic. Haeckel (1999) states that when organisations are fully committed to viewing information as a resource the organisation will be rewarded in terms of business agility, productivity, effective use of information and improved profitability. However information architectures are dynamic and the feedback from business users will be used to adapt the information architecture. In addition business user’s information needs are dynamic which means that the information architecture will change with time.

3.4.4 Understanding grocery retailers reporting requirements

Figure 3.5 shows the generic reports type required by the different levels of management in grocery retailers. The type of report required are due to the different types of decisions that the particular level of management are dealing with. For the purpose of this research the management are broken into two broad groupings. Firstly there are the store and department management and secondly there are the regional and senior level management.

![Figure 3.5 Different types of reports required by different level of management and the type of decision they are used to address (Author, (2007).](image)

Both department and store management generally require structured reports. A structured report is required at this level of management because they are dealing with
planned decisions. This makes their different information requirement easy to define and pre-written queries can be generated to extract the relevant information. A possible format for the structured report is that of a scorecard which identifies a number of key performance indicators (KPI). These key performance indicators can be agreed with individual management teams.

Regional management are dealing with semi planned decisions. This means regional management will require both structured and investigative reporting capacity. The structured reporting will be summarised data from the reports that the store and department managers receive. In addition they will require the ability to perform ‘ad hoc’ queries. The senior level of management are dealing with unplanned decisions which makes their information needs difficult to define. This necessitates that they have the ability to access unstructured reports as well summarised structured data which ideally should allow the ability to be drilled down through. A key function of the information architecture is to clearly define what the information requirements are of the different levels of management.

3.5 Conclusion

There are a number of factors which are driving the grocery retailer’s need to have an efficient and effective Business Intelligence (BI) system. The major drivers are Customer relationship management (CRM), intense competition, advent of super chain stores and Business performance (BPM). The reality is that many of these factors are interrelated. For example the advent of super chain stores has greatly increases the competition with the sector, which means retailers need to ensure they are performing effective Customer relationship management (CRM) to retain their market share. Additionally the management of these super chain stores are performing Business performance management (BPM) which further heightens their need for Business Intelligence (BI) systems. The fact that there are so many drivers of Business Intelligence (BI) systems indicates that they have now became a competitive necessity for grocery retailers. There are a number of applications of Business Intelligence (BI) systems to grocery retailers. The focus of this research is on the customer relationship management (CRM) applications. However the information extracted from Business Intelligence (BI) systems has various applications in Irish grocery retailers. To
develop effective Business Intelligence (BI) systems retailers must a firm understanding of the information requirements of the different levels of management. The use of information architectures enables retailers to gain a firm understand the information in their organisations and their information requirements. Once the retailers have created and fully understand their information architecture they will then be a position to utilise Business Intelligence (BI) effectively.
4  ANALYSIS OF THE USAGE OF BUSINESS INTELLIGENCE (BI) TOOLS IN IRISH GROCERY RETAILERS.

4.1 Introduction

This chapter presents the findings of the survey analysis into the usage of Business Intelligence (BI) in Irish grocery retailers. This survey was not intended to evaluate the different functionalities of Business Intelligence (BI) tools available to retailers, instead its purpose was to evaluate how successful these tools are at meeting the information needs of retail management. The retailers themselves have little interest in the various functionalities of the different Business Intelligence (BI) tools available. However they are interested, and dependent upon these tools, for supplying retail management with the necessary information to make effective decisions. Therefore it is prudent to evaluate these systems not on their technical terms but instead on their information providing capacity. There have been a number of surveys completed regarding the Business Intelligence (BI) systems which all focused on the technical functionalities of the various Business Intelligence (BI) tools available (SAS, 2007; Burns, 2004 & Burns, 2005). A copy of the survey used in this dissertation is available in appendix A. The survey itself had a number of objectives:

- Verify the need for the use of information architecture to maximise the return from Business Intelligence (BI) systems.
- Evaluate how successfully Business Intelligence (BI) systems are being used by Irish grocery retailers. This evaluation is based on reports and information extracted from these systems.
- Establish what different levels of management require from their Business Intelligence (BI) systems in terms of reports.

To achieve these objectives 17 questions were used. The questions varied in style. Both open and closed ended questions were used. Data was analysed using Statistical Package for Social Science for Windows version 14.0. The data was graphed in Microsoft Excel. Appendix C contains the screen shots of the variables defined in SPSS in order to perform the analysis.
4.2 Respondents to the survey

In all an attempt was made to survey 100 retail managers in various different Irish grocery retailers by phone during a two week period. The survey was administered over the phone which has the advantage of ensuring a higher level of data accuracy as questions were explained to respondents if they were unclear (Fink, 1995). As with all surveys their common aim is to generalise from a sample to the overall population (Babbie, 1990). The population in this case being retail management in Irish grocery retailers. A survey was utilised in this research as it afforded a quick and reliable collection method for data. The data was cross sectional i.e. the data was collected at one point in time. Overall 66 individuals responded to the survey which represents a response rate of 66%. Only one individual manager was surveyed from each outlet. The breakdown of the different management positions held by the respondents in their respective organisations is shown in figure 4.1.

![Pie chart showing the breakdown of management positions]

Figure 4.1 Position of respondents in the retail organisation (Author, (2007)).

4.3 What do retail managers need to know

As part of question 14 the survey respondents were presented with a number of pieces of retail information and asked to rate the importance of each piece of information to the retail decision making process. These individual pieces of information e.g. customer’s opinion of value for money in the outlet, were compiled from the experience of the author of this dissertation in working with retail managers and
gathering information they considered important to enable them to make effective retail management decisions. For each piece of information the respondent was asked to rate its importance to the retail decision making process on a scale between 1 and 6, 1 being extremely important and 6 being not important. The pieces of information were listed on the survey in no particular order. As can be seen in table 4.1 all of these pieces of information were considered important to the retail decision making process. With no piece of information be assigned a 4, 5 or 6. The obvious conclusion formed from this is that to make effective retail management decisions managers need to have access to all of these pieces of information. The retailers placed a lot of emphasis on knowing financial details. With 100% of respondent stating that it is extremely important to know the sales figures by department.

<table>
<thead>
<tr>
<th></th>
<th>Extremely Important</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Not important</th>
</tr>
</thead>
<tbody>
<tr>
<td>Who their most valuable customers are</td>
<td>65.6%</td>
<td>31.3%</td>
<td>3.1%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>How successful promotions were</td>
<td>71%</td>
<td>29%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Average spend of customers</td>
<td>56.7%</td>
<td>33.3%</td>
<td>3.3%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Customer profile</td>
<td>63.6%</td>
<td>36.4%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Customer opinion of product range</td>
<td>69.7%</td>
<td>30.3%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Customer opinion of staff friendliness</td>
<td>60.6%</td>
<td>39.4%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Customer opinion of value for money</td>
<td>60.6%</td>
<td>39.4%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Customer opinion of store layout</td>
<td>60.6%</td>
<td>39.4%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Customer opinion of parking facilities</td>
<td>57.6%</td>
<td>42.4%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Customer opinion of opening hours</td>
<td>60.6%</td>
<td>39.4%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Sales by department</td>
<td>100%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Competitor information</td>
<td>71%</td>
<td>29%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Sales by product</td>
<td>45%</td>
<td>35%</td>
<td>20%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Sales by time</td>
<td>49%</td>
<td>31%</td>
<td>20%</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
</tbody>
</table>

Table 4.1 Ratings of the importance of individual pieces of information to the retail decision making process (Author, (2007)).
4.4 **Current level of knowledge of retailers**

As part of questions 15 and 16 from the survey retailers were asked a number of questions pertaining to their levels of knowledge about different key retail facts. These key pieces of retail knowledge are the same as those used in question 14 of the survey. As discussed in section 4.3 retailers considered all of these pieces of information important to the retail decision making process, therefore as part of question 15 and 16 they were asked if they knew this information about their own outlet and customers. For each piece of information they were asked to give a yes or no answer to whether or not they know this information. The results are shown in table 4.2.

<table>
<thead>
<tr>
<th>Information</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Who their most valuable customers are</td>
<td>78.8%</td>
<td>21.2%</td>
</tr>
<tr>
<td>How successful promotions were</td>
<td>75.8%</td>
<td>24.2%</td>
</tr>
<tr>
<td>Average spend of customer</td>
<td>78.8%</td>
<td>21.2%</td>
</tr>
<tr>
<td>Customer profile</td>
<td>75.8%</td>
<td>24.2%</td>
</tr>
<tr>
<td>Customer opinion of product range</td>
<td>63.6%</td>
<td>33.4%</td>
</tr>
<tr>
<td>Customer opinion of staff friendliness</td>
<td>56.3%</td>
<td>42.7%</td>
</tr>
<tr>
<td>Customer opinion of value for money</td>
<td>56.3%</td>
<td>43.7%</td>
</tr>
<tr>
<td>Customer opinion of store layout</td>
<td>62.5%</td>
<td>37.5%</td>
</tr>
<tr>
<td>Customer opinion of parking facilities</td>
<td>56.3%</td>
<td>43.7%</td>
</tr>
<tr>
<td>Customer opinion of opening hours</td>
<td>60%</td>
<td>40%</td>
</tr>
<tr>
<td>Competitor information</td>
<td>70%</td>
<td>30%</td>
</tr>
<tr>
<td>Sales by department</td>
<td>100%</td>
<td>0%</td>
</tr>
<tr>
<td>Sales by product</td>
<td>20%</td>
<td>80%</td>
</tr>
<tr>
<td>Sales by time</td>
<td>90%</td>
<td>10%</td>
</tr>
</tbody>
</table>

**Table 4.2 Response to questions regarding the retailer knowledge of certain facts (Author, 2007).**

From table 4.2 it is clear that despite the fact retail managers consider these pieces of information to be important to enable effective decision making, a large number of respondents are not aware of these facts. The only piece of information which returned a 100% reply was sales by department while sales by time also had a high rate at 90%. Many of the retail managers did not know pieces of information which would be
consider important to know to enable effective Customer relationship management (CRM) e.g. only 63.6% of retail managers knew what their customer’s opinion of product range was.

Also as part of questions 15 and 16 retailers who replied yes to knowing the pieces of information were asked what they based their answer upon. For example if a retail manager replied that they knew who their most valuable customer were they further asked if they knew this because of their own experience in the retail sector or because of the various Business Intelligence (BI) systems reports they receive. So for each piece of information that they stated they knew, they were asked if they knew it because of experience or reports. The two possible answer, reports or experience, were not mutually exclusive i.e. they know could a piece of information based on both reports and experience. The results of this question are given in table 4.3.

<table>
<thead>
<tr>
<th>Information</th>
<th>Experience Only</th>
<th>Reports only</th>
<th>Both experience &amp; reports</th>
</tr>
</thead>
<tbody>
<tr>
<td>Who their most valuable customers are</td>
<td>65.4%</td>
<td>0%</td>
<td>34.6%</td>
</tr>
<tr>
<td>How successful promotions were</td>
<td>68%</td>
<td>0%</td>
<td>32%</td>
</tr>
<tr>
<td>Average spend of customers</td>
<td>69.2%</td>
<td>3.8%</td>
<td>26.9%</td>
</tr>
<tr>
<td>Customer profile</td>
<td>72%</td>
<td>0%</td>
<td>28%</td>
</tr>
<tr>
<td>Customer opinion of product range</td>
<td>71.4%</td>
<td>0%</td>
<td>28.6%</td>
</tr>
<tr>
<td>Customer opinion of staff friendliness</td>
<td>72.2%</td>
<td>5.6%</td>
<td>22.2%</td>
</tr>
<tr>
<td>Customer opinion of value for money</td>
<td>72.2%</td>
<td>0%</td>
<td>27.8%</td>
</tr>
<tr>
<td>Customer opinion of store layout</td>
<td>20%</td>
<td>0%</td>
<td>80%</td>
</tr>
<tr>
<td>Customer opinion of parking facilities</td>
<td>38.9%</td>
<td>38.8%</td>
<td>22.2%</td>
</tr>
<tr>
<td>Customer opinion of opening hours</td>
<td>33.3%</td>
<td>5.6%</td>
<td>61.1%</td>
</tr>
<tr>
<td>Competitor information</td>
<td>100%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Sales by department</td>
<td>0%</td>
<td>100%</td>
<td>0%</td>
</tr>
<tr>
<td>Sales by product</td>
<td>0%</td>
<td>90%</td>
<td>10%</td>
</tr>
<tr>
<td>Sales by time</td>
<td>0%</td>
<td>81%</td>
<td>19%</td>
</tr>
</tbody>
</table>

Table 4.3 When the answer was yes in table 4.2 what the source of their knowledge (Author, (2007)).
The majority of the knowledge the retailer has about its customers are based upon experience and implicit knowledge. This clearly indicates that while retail organisations are using Business Intelligence (BI) tools there still remains problems with getting the information to the retail managers. A new approach is required to ensure that retail managers have access to the actionable information they require to enable effective decision making. There are a number of possible reasons for this failure to get the information to the retail managers:

- This information does not exist within the organisation. Although the data exists within the organisations perhaps the relevant information is not being extracted. The use of an information architecture will solve this problem as it will indicate to those involved in extracting the information, what information is required by different levels of management, and where this information can be found.

- It could also be a knowledge management issue, perhaps the information is being extracted but it is not being shared throughout the organisation. This may be due to a lack of a reporting structure or perhaps a cultural issue against sharing valuable information. The use of an information architecture will facilitate the creation of information reporting structure indicating where the information needs to flow to. If it is a cultural issue the information architecture can be used as part of training programme which would be necessary to promote a culture of knowledge sharing.

Retail managers basing their decision making mainly on implicit knowledge creates two problems for the retail organisation:

- It has no way of verifying that this knowledge is correct. The retailer may be basing their decisions upon their opinions created through their own experience as a consumer. This knowledge by its very nature is subjective and alone is not a secure foundation on which to base the retail decision making process.

- Implicit knowledge by its nature is retained within the mind of individuals. This means all this knowledge is lost if these individuals leave the organisation. It would be highly advisable that some form externalisation takes place in order to create an artefact regarding this knowledge.
The focus of the reports received by retail management is on the sales data. These reports are based upon the data from the electronic point of sales (ePOS) system e.g. all the retail managers received reports regarding the sales figures by department.

The results of this survey are in general agreement with those presented from the SAS institute survey (2007). In that particular survey 175 business personnel were asked about their Business Intelligence (BI) systems and only 18% stated that their organisation had a ‘unified trustworthy information source to drive decision making’.

### 4.5 Retail managers satisfaction with reports received

The respondents were asked two questions to evaluate their level of satisfaction with the information and reports they received. Question 7 asked them to rate the information and reports they received on a scale of 1 to 5, 1 being extremely dissatisfied and 5 being extremely satisfied. Figure 4.2 shows their responses to this question.

![Retail managers rating of the information and reports they receive](image)

Figure 4.2 Retail managers rating of the information and reports they receive (Author, (2007)).

It is clear from figure 4.2 that overall satisfaction levels with the information and reports received are quite low. Only 24 of the 66 managers surveyed described themselves as satisfied with the information and reports they received, this represents 36.4% of the managers. The remaining 63.6% of respondents described themselves as indifferent, dissatisfied or extremely dissatisfied with information and reports they...
receive. This clearly indicates that while Business Intelligence (BI) tools are widely used in the Irish grocery retail sector there still remains a high level of dissatisfaction with them from the end users. The high level of dissatisfaction is not surprising when the results of section 4.4 are considered and the fact retail managers base a significant amount of decision making on implicit knowledge.

The respondents were asked a further question to evaluate how useful they found the information they received. Question 8 asked respondents to describe the information and reports they received. Respondents were asked to choose the one which most closely described their opinion of the reports they receive. The responses to this question were mutually exclusive. Of the 66 responses to this question 25 described the information they receive as ‘valuable information for retail management’ which represents 37.8%. However of these 25 responses 17 came from regional managers. It is obvious that the level of satisfaction with reports is related to the level of management.

Figure 4.3 represents what regional managers view of the information and reports they received was while figure 4.4 represents the store managers and department managers view of the information and reports they received. It is clearly evident from these charts that there is a difference in opinion between the different levels of management. Figure 4.3 shows that of the 20 regional managers surveyed 17 described the information they received as ‘valuable information for retail management’. This represents 85% of regional managers. In contrast to this figure 4.4 shows that of the 46 store and department managers surveyed only 8 of them described the information they received as ‘valuable information for retail management’. This represents 17.4% of store and department managers. A further clear indication of the level of dissatisfaction with information received by department managers and store managers is the fact that 22 of the 46, which represent 47.8%, responses from these managers described the information they received as ‘useful but missing some important elements’. The usage of an information architecture would enable the identification of the important elements which should be included in the information and reports. From this data it is apparent that the focus of informational reports extracted from the Business Intelligence (BI) systems of Irish grocery retailers are targeted towards middle to higher level management. Store and departmental mangers informational
needs are being neglected this has a number of important implications not least of which is the fact that these managers lack the required information to perform effective Customer relationship management (CRM). This lack of access to appropriate information highlights the need for the use of information architectures.

Figure 4.3 Regional managers opinion of the information they receive (Author, (2007)).

Figure 4.4 Store managers and department managers opinion of the information they receive (Author, (2007)).

4.6 Presentation of extracted information and reports

Question 11 of the survey evaluated how well the information in the reports is presented in terms of how easy it is to understand. The respondents were asked to rate
the presentation of the reports on a scale of 1 to 5, 1 being difficult to understand and 5 being easily understood. The results of the question are presented in figure 4.5.

Figure 4.5 Managers rating of how well the information was presented in reports in terms of how easy it was to understand (Author, (2007)).

As can be seen from figure 4.5 the overall level of satisfaction with the presentation of the reports is quite high with 68.2% giving the presentation a rating of 4 or 5. From section 4.5 it is clear that there is quite a high level of dissatisfaction with reports received with 63.6% being dissatisfied. Given the relatively high level of satisfaction with the presentation of the reports it can concluded the dissatisfaction with the reports is not due to their presentation.

4.7 Capability of extracting their own reports

Figure 4.6 represents the number of managers which have the capability of extracting their information or reports. As can be seen from the chart only 8 managers are capable of extracting their information or reports. This inability to create their own reports maybe a factor in the level of dissatisfaction with information and reports received. Question 13 of the survey was an open ended question which allowed respondents to make any comments about the survey and information they receive. Due to fact that it was open ended any analysis of its data was difficult. However a number of the respondents suggested through this question that the ability to extract their own reports in their own time would improve their decision making ability. They described their frustration at the fixed nature of the reports and the inability to run ‘ad hoc’ queries.
This indicates that there is a definite role for dashboard technologies to facilitate retail managers access to the necessary information required for decision making. Alternatively they may be given access to a portal site which would enable them to view the data they require.

![Pie chart showing 88% Yes and 12% No.](image)

**Figure 4.6 Number of managers capable of extracting their own reports (Author, (2007)).**

### 4.8 Reporting improvements

Question 10 of the survey was an open ended question which allowed respondents to suggest any changes they would make to reports and information they receive. The question allowed respondents to suggest up to ten different changes. However the question had a very low response rate. Figure 4.7 represents the first suggestion made by respondents. As can be seen from figure 4.7 of sample of 66 surveyed 22 did not have any suggestion to make for changes to the reports. This represents 33.33% of the sample surveyed. Of the remaining 44 respondents 28 suggested having the ability to access their own reports and information. This represents 42.4% of the sample surveyed. There is a frustration among the respondents that know valuable retail information exist but they do not have access to it. A further 13 respondents, which represents 19.7%, stated that a major improvement would be the integration the data from different sources. Question 13 of the survey which was opened ended, allowed respondents to make any comments about the information and reports they receive. A number of these comments concerned the fact that there was no integration of data from the different sources
4.9 **Key findings and conclusions**

Having access to a wide variety of information is considered important by retail managers in order to ensure they are capable of making effective retail decisions. Despite the fact that all retail organisation surveyed are using Business Intelligence (BI) tools retail managers are still presented with a number of information gaps which affects their ability to make effective decisions. The Business Intelligence (BI) report currently extracted are focused primarily on data from the electronic point of sales (ePOS) system. There is lack of integration of data from the different sources. This results in retail management receiving separate reports about different functions of their business. This prevents management from getting a holistic cross functional view of their business.

The fact that the reports that management receive lack some of the required information has resulted in many retail managers basing their decisions upon implicit knowledge. This implicit knowledge is gained from the managers own experience and despite the fact that they are using it as the foundation to make decisions there is now way of knowing if the knowledge is correct. A further implication of the increased use of implicit knowledge is the fact that if these individuals leave the organisation all this knowledge leaves with them.
Generally there are high levels of dissatisfaction with the information and reports received by managers. However the level of this dissatisfaction is related to the level of management. Store managers and department are particularly dissatisfied with the reports. The reports tend to be focused towards regional and senior level management. There are a number of possible reasons for this dissatisfaction. The major reasons are:

- Lack of integration of data from different sources in the reports
- Inability to access and extract their own information from the Business Intelligence (BI) system.
- Reports are missing key informational elements.

The presentation of the information and reports is not the source of dissatisfaction with these reports.

The fact that the information requirements of store and department managers can be clearly defined should mean that their information requirements are easy to satisfy. The majority of retail managers are not capable of extracting their own information and reports. This inability is a source of frustration to retail managers and is a factor in the high levels of dissatisfaction managers expressed towards the information and reports they received. However due to the fact store and department managers information needs can be clearly defined means that they do not require access to the data. An information contract should be developed which would specify the key performance indicators (KPI) that store and department managers require in their reports. These report could then be delivered in the form of scorecards. A fixed timeframe could then be agreed for the delivery of these reports.

The level of dissatisfaction and information gaps currently in the reports received by management in the Irish grocery sector warrants a rethink of how Business Intelligence (BI) systems are deployed and used. The use of an information architecture as a starting point in the usage of Business Intelligence (BI) systems offers an alternative approach that can ensure that managers in the Irish grocery retail organisation have access to the information they require to make effective decisions.
5 INFORMATION ARCHITECTURE FOR IRISH GROCERY RETAILERS

5.1 Introduction

Drawing from the learning gained from performing the literature reviews in chapter 2 and 3, and combining this with the insights gained from the analysis of the survey data in chapter 4, this chapter presents an information architecture for Irish grocery retailers. This information architecture is presented from different perspectives, which each represent a different level of management who interact with the information architecture. The first view is that of the department or store management. The second view is that of regional and senior level management. The third final view of the information architecture is an integrated view of the two perspectives and some of the information technology issues relating to it. This final view of the information architecture is suited to the information technology personnel or the technically confident business person.

While these are generalised views the business reality is that every retail organisation will have a different set of standard operating procedures (SOPs) and information requirements which means that their particular information architecture will be unique. The information architecture presented in this dissertation can be considered the ideal information architecture for grocery retailers, which allows them to compare it to their information architecture and identify any gaps or weaknesses.

5.2 Methodology used for creating the Information architecture for Irish grocery retailers.

To create an effective information architecture an in-depth understanding of the business objectives, constraints, content and requirements of business users who will use the Business Intelligence (BI) system was required. Additionally an understanding of the application of the different Business Intelligence (BI) tools was required. The approach used to developing the information architecture in this dissertation was to view the information architecture as having three contributing factors which were
considered and understood in order to create and effective information architecture. Figure 5.1 represents the three contributing factors which were considered when developing the information architecture for the Irish grocery retailers. Each of these factors was carefully considered when developing the information architecture. The arrow coming from each of the factors indicates that information from each of them contributes to the information architecture.

![Diagram](image)

**Figure 5.1 Factors considered during the development of an information architecture for grocery retailers (Author, 2007).**

The first factor considered was the retail environment. It was essential to develop an understanding of the retailer’s objectives, policies, standard operating procedures, culture and the competitive forces facing retailers. It was important to establish what the information landscape of grocery retailers was. This involved understanding what data the organisation captures, where the data is stored and how the data flows throughout the organisation. Additionally the drivers of Business Intelligence (BI) for Irish grocery retailers was considered. For the purpose of this dissertation this information was gathered through the literature review in chapter 3.

The second factor considered was the end users of the Business Intelligence (BI) system. There are various different user groups of Business Intelligence (BI) systems in Irish retail grocery companies. Each of these groups has different requirements from
the Business Intelligence (BI) systems. These users’ requirements were established through the analysis of the survey data. For the purpose of this dissertation the users were broken into three different groups according to the level of management at which they operate. For an information architecture to be successful it must clearly understand and incorporate the information needs of its various business users at the different levels of management. Understanding the information needs of different levels of management can be difficult as often the management are not that clear themselves on what their information requirements are.

The third factor that was taken into consideration was the available Business Intelligence (BI) tools and their various different applications. These were critically reviewed in chapter 2. Once the information from the three contributing factors was established they were combined to form the information architecture. This information architecture is viewed from three different perspectives.

5.3 Information architecture for store and department management

Figure 5.1 shows the information architecture for the store and department managers in Irish grocery retailers. This is the first view of the information architecture and provides the basic business view. It is the simplest of the three views presented.

The basis operational systems of the retail organisation provide the data which are the foundation on which the information architecture is based. One of the primary sources of data for all grocery retailers is their electronic point of sales system (ePOS). Despite its pivotal role in providing information, its primary objective is to enable the completion of business transactions. All of the respondents questioned in the survey stated that they used electronic point of sales (ePOS) systems. However taken in isolation electronic point of sales (ePOS) systems can only provide information about financial transactions. In order to provide store and department management with holistic information the electronic point of sales (ePOS) data must be integrated with the various other sources of data from different operational systems. The most obvious data to be integrated is that from the electronic point of sales (ePOS) and the loyal card system.
Figure 5.2 Information architecture for store and department managers (Author, (2007)).
Once these data sources are integrated they can provide store and department management with a powerful source of data. However in a situation where retailers are not using a loyalty card system, which is the case for convenience stores, other sources of data must be used. The majority of retailers are also using mystery shopper reports and customer satisfaction reports. Again these sources of data must also be integrated with other sources of data. Retailers which are using Enterprise resource planning (ERP) have an advantage over other retail organisations when it moves to the next stage of the architecture which is the integration of the data sources.

The first major information technology based process is the integration of data from the various different operational systems. Because this is the basic business view of the information architecture no explanation or description of the complex integration techniques which would have to be employed are given. However the integration is a critical step, as evidenced by the survey data where a number of respondents described their frustration with the separate pools of information and reports and the lack of integration. In order to provide managers with a holistic enterprise wide view of the data it is essential that the data from the various different operational sources is fully integrated. For example currently retailers are receiving sales data reports which are extracted from their electronic point of sales (ePOS) systems and customer satisfaction reports based upon the data gathered after the execution of customer satisfaction surveys separately. In order to maximise the benefit of these reports to store and department management they must be integrated.

The next stage of the information architecture is the data store or repository where the integrated data from the various operational systems is held. There are three possible repositories for the data; data warehouses, operational data stores or data marts. A retail organisation may decide to use a combination of these data stores depending upon the information technology infrastructure available. The type of access the retail organisation wish to allow to the store and department managers will also affect the choice of data store. If the company are going to centrally run the reports and send them to the store and department managers it will most probably suit their needs to have a data warehouse in operation which will not allow access to department and store management. If the company want store managers and department mangers to be capable of accessing the information and reports themselves it may be most
appropriate to use a operational data store or a data mart. The key point is regardless of who is accessing the data, and from what data store, that it provides an integrated, current and historical view of all the data. Because the information needs of department and store management can be clearly defined and are well structured there is little need to for them to have the ability to be able to access the data themselves. Instead there should be a fixed reporting structure whereby they periodically receive the reports they require to enable them to make effective decisions.

The next process of the information architecture is the application of the appropriate analytical tools to the selected and relevant data within the data store. From section 3.5 of the literature review it is clear that the information required by department and store managers is well structured and predictable. Therefore well defined and structured queries will yield agreed upon elements of the structured reports. These structured queries will involve the simple reporting and monitoring of key performance indicators (KPI). Many of queries required to extract the relevant information will involve simply modelling e.g. sales by department. In addition to the standard queries for modelling the key performance indicators (KPI) online analytical processing techniques may also be deployed to fulfil their information needs. Online analytical processing (OLAP) was reviewed in section 2.4.

The next process is that of the report generation which is also directly related to the access to information or delivery method of the various reports. Although the survey data indicated that store and department managers wanted to have the capability to access and generate their own reports, the author of this dissertation is of the opinion that it is not advisable for a number of reasons:

- Store and department manager’s information needs are clearly defined. Therefore an agreed upon reporting structure can yield all the information they require. Standard queries can be written to extract the relevant information. This information can then be sent to the relevant parties either in hard copy format or through email. Because their information needs are clearly defined they do not need the ability to run ‘ad hoc’ queries.
- To have the technology in each outlet to access the data store and to run the reports would result in an additional cost to the organisation. It would also create another information technology based tool to be supported.
- Having to generate their information and reports would increase time pressure on store and department managers. In addition training maybe required by staff to enable them to use the system.

The reports themselves should be created by analysts who should operate at the regional level. The role of the analyst may well be performed by the regional managers themselves.

The next stage of the information architecture is the reports themselves. The reports will be structured due to the well defined information needs of store and department managers. The selection of appropriate key performance indicators (KPI) is essential. Equally important is that everyone involved has a clear understanding of the meaning and significance of each key performance indicator (KPI). Once the key performance indicators (KPI) are clearly defined and agreed upon, the structured reports can take the form of score cards, which contains each of the agreed upon key performance indicators (KPI). These score cards provide and easily understood method whereby store and department management monitor their performance compared to the overall strategy of the retail organisation. Score cards also provide a timeline indicating the performance of the retail outlet.

The next stage of the information architecture is concerned with the access and delivery method of the reports. As stated previously there is no need for store and department managers to have the ability to run their own reports. The store and department managers should have an agreed reporting structure and timeframe with their regional analyst. For example there should be an agreement covering the key performance indicators (KPI) to be contained in their weekly, monthly and annual reports. These reports can then be delivered through email or in hard copy format to the appropriate store and department managers.

The final stage of the information architecture involves the store and department managers choosing appropriate application areas. The use of this information architecture approach ensures that store and department managers have integrated information which provides a holistic description of the operations taking place within their retail organisation. For example if management observes that the sales figures for
the deli department has dropped over a year, they may consult the information from the
customer satisfaction surveys data to investigate any possible reasons. This integrated
view of data provides a vastly improved situation compared to the current situation
where managers are presented with separate pools of information from which to base
their decisions. Once the store and regional management are receiving the appropriate
information and reports they can use the knowledge gained to assist in the decision
making process. The application areas chosen by store and department manager will
always be concerned with internal store operations.

5.4 Information architecture for regional and senior management

The second perspective of the information architecture is shown in figure 5.2 and is
that of the regional and senior management. The elements that are specific to this
perspective of the information architecture are contained in the green boxes. This view
of information architecture contains slightly more technical details and varies from that
of the store and department management because of the more dynamic and complex
information needs of regional and senior management.

The fundamental operational systems which are the data sources for the Business
Intelligence (BI) systems obviously remain the same. However senior management in
particular will be also be concerned with external sources of information e.g. actions of
competitors or developments in an outlet’s hinterland. The information required by
store and department management can all be obtained from internal systems. However
the information required by regional and senior management may require external
sources of information in addition to the internal sources. The inclusion of external
sources of data can cause problems at this next stage of the information architecture
which is the integration of the data sources.

The details of the integration of the various data sources are included in this
perspective of the information architecture. From the survey the lack of integration
between informational reports was highlighted as a weakness. Therefore integration is
essential. However the integration of data from the various different operational
sources can be quite technically challenging. The integration of the data will involve
Figure 5.3 Information architecture for regional and senior level management (Author, (2007)).
the extraction, transformation and loading of the data into the data warehouse. The approaches to the extraction, transformation and loading of data are discussed in section 2.2. Of particular importance to the regional and higher level management is the data quality.

The data quality is dependent on a number of factors with the data cleansing procedures being particularly important. Data quality is considered essential because this data is the basis on which retail management are making their decisions. Regional and senior level management have to make decisions regarding the handling of missing data and outliers. These decisions must then consistently implemented.

The data store presented in this perspective of the information architecture is that of a data warehouse. Due to the fact that regional and senior managers are concerned with the performance of various retail outlets, there is no necessity for operational data stores or data marts. The data warehouse will contain the data from various different outlets and the regional and senior management will have access to it. Data warehouses and the different possible designs that they may take are discussed in section 2.2.

The next stage of the information architecture is concerned with the application of the analytical tools to the selected data. Due to the more complex and dynamic information needs of regional and senior level management, the analytical tools are obviously more sophisticated than those required by department and store managers. The increased complexity of their information needs is due to the fact that these levels of management are dealing with semi planned and unplanned decisions. In addition to the simple modelling information required in order to facilitate the monitoring and controlling of the organisation regional and senior management will also require more complex analysis methods. An example of an unplanned decision would be where to locate a new outlet. For this example management would require both structured and unstructured queries. It would require the application of such analytical tools as Geographic information systems (GIS) to assist in evaluating the need for a new outlet in a particular area. Visualisation technologies are also very important as the ability to view large amounts of data easily makes it more useful for management. The
capabilities and applications of each of the different analytical tools in the information architecture are discussed in chapter 2.

The next stage of the information architecture is concerned with how the regional and senior management can access the information they require. The access method to the information and reports for regional and senior management varies greatly from that required by store and department management. Due to the nature of their positions regional and senior management should have instant access to information they require. While the information needs of store and department management are clearly defined, the information needs of regional and senior management are only partially defined and dynamic in nature. For example regional and senior management will require periodic reports describing the key performance indicators (KPI) of different retail outlets. They will also have ‘ad hoc’ queries which require an immediate response and therefore access to the data warehouse. There are a number of options which may provide this including dash boards, portal sites and web services. In many cases these different technologies have converged.

Turban (2006) described web services as modular business and consumer applications which are capable of providing users with the ability to access, through the web, data from various different sources. This enables retail management to select and combine data from across disparate systems thereby enabling the sharing of data. The use of web services requires a set of shared protocols and standards. In essence it provides retail management with access to real time links to the various online processes of different systems within their organisation. However to make effective use of the data from the various systems they must be presented in a user friendly manner. This is where dash boards are utilised. Dash boards enable regional and senior management to monitor and display the key performance indicators (KPI) through the use of on screen visuals.

Another option to provide regional and senior management with access to the information is through the use of portal sites. A web portal is a web site that functions as a normal World Wide Web site which provides regional and senior management with a point of access to information they require. The portal will represent the
required information which will have been taken from various sources in a suitable fashion.

The information needs of regional and senior management in contemporary Irish grocery retailers can be quite complex. Similar to store and department management they will have a number of structured reports requirements which are primarily concerned with the reporting of key performance indicators (KPI). However they will also have a number of unstructured information needs which are dynamic and difficult to define. Because some of the information needs of regional and senior management are dynamic it is necessary that they have the ability to run their own queries and extract their own information hence the need to have access to the data. Some of the information requirements of regional and senior management can be defined and structured. These are basically summarised versions of the information which the store and department management receive. Score carding can also be a useful manner of presenting the data for regional and senior management. For example sales figures can be compared across different outlets. Again there should be an agreed upon structure to these reports and similarly an agreed timeframe for their delivery. The receipt of these reports may raise a number of questions that the regional or senior managers may find the answer to by drilling down through the data. The various online analytical processes (OLAP) operations which management require to enable the further investigation of data are discussed in section 2.4.

The application areas for the extracted information will vary depending on the level of management. The store and department manager’s application areas will have an internal focus i.e. they are concerned with internal store operations. The regional management will be concerned with the performance of a number of retail outlets and so be concerned with internal and external issues. The senior management are concerned with strategic issues which will be affected by both internal and external factors.

5.5 **Integrated Information architecture**

The third view of the information architecture is the integrated view which is suitable for information technology personnel and technology confident business users. In
addition to integrating elements from the two previous perspectives of the information architectures, it also highlights some of the main information technology factors affecting the Business Intelligence (BI) system. Things taken into consideration in this perspective include metadata, security and privacy issues and the hardware and software platforms. These factors are clearly very important in the Business Intelligence (BI) information architecture but also span across other information technology systems.

The data sources here include any of the enterprise systems which may contain relevant data. In addition external sources must be taken into consideration for example data concerning tax changes, interest rates changes and the action of their main competitors. Some of the data sources maybe unstructured and pose difficulties when they have to be integrated with other sources of data. The responsibility for physically integrating the various sources of data is that of the information technology personnel.

The viewers of this perspective of the information architecture will be concerned with details of the extraction, transforming and loading of the data from the various data sources in a single repository i.e. the data warehouse. Therefore this perspective of the information architecture shows a data staging area. This is a place where the raw data from the different sources is placed in order for it to be cleaned, combined, archived and eventually loaded to the appropriate data warehouse or data marts. The overall objective of data staging is to get the data ready for loading into the data warehouse. The data staging area does not provide a querying facility. The viewers of this perspective of the information architecture are also responsible for the data quality and integrity. The procedures and standard practices which have been developed to deal with missing and noisy data must be consistently implemented by information technology personnel.

Within Business Intelligence (BI) systems metadata is utilised throughout many of the processes e.g. the analysis of the retail data and loading of the data from the operational into the data warehouse. Business Intelligence (BI) metadata will describe and define how the data is to be stored, queried, filtered, analysed, and displayed in Business Intelligence (BI) system.
Figure 5.4 Integrated information architecture (Author, (2007)).
There are a number of different types of metadata required within a typical Business Intelligence (BI) system in a retail organisation including the following:

- Online analytical processing (OLAP) metadata which are used to describe the structure of the dimensions, the cubes that will be generated and the various drill paths that can be followed.
- Reporting metadata which are used to describe the structures of reports, charts, queries to produce the data to be contained in the reports, and the various filters and variables required to produce the reports.
- Data Mining metadata which are used to describe the structures of the various datasets, algorithms and queries.
- Metadata concerned with the extraction, transforming and loading of data from the various different sources into the data warehouse or whatever data repository is chosen.

A good understanding of Business Intelligence (BI) metadata is required to fully utilise all the capabilities of retail Business Intelligence (BI) system. It is the responsibility of the information technology personnel, who are viewers of this perspective of the information architecture, to have this full understanding of the metadata.

The information technology personnel will also be concerned with ensuring that the security rules and procedures are followed. The Business Intelligence (BI) system will hold large amounts of personal data and it is important that rules and laws are adhered to e.g. Data protection act 1988 and 2003. The information technology personnel must also deal with the hardware and software issues which provide the platform for the Business Intelligence (BI) system.

5.6 Conclusions

This chapter presents the information architecture for Irish grocery retailers using or introducing Business Intelligence (BI) into their organisations. The use of the information architecture approach to building and using Business Intelligence (BI) systems for grocery retailers can ensure that retail management have the appropriate information they require to make affective decisions. To build the information architecture three contributing factors were taken into consideration: the retail
environment, the users and the various Business Intelligence (BI) tools. Each of these factors was taken into consideration either through the completion of a literature review or the analysis of the survey data. Combining these factors resulted in the creation of the information architecture.

The information architecture approach requires that the different levels of management have their own perspective on the information architecture. For the purpose of this research management were divided into the three levels, store and department managers, regional and senior managers and the information technology and technology confident business user.

The department and store management’s view of the information architecture is the simplest view. Their information requirements are well defined and structured which means their information requirements can be easily met. The well defined information needs of these managers means that they do not require the capacity to run their own reports. Instead a set of Key performance indicators (KPI) should be agreed which could be delivered to the managers in the form of a scorecard in a predefined timeframe. The clearly defined information requirements of department and store management also means that relatively simple analytical tools will yield the information they.

The second perspective of the information architecture is that of the regional and senior management. The information needs of these levels of management are more complex, requiring both structured and unstructured information. The structured information will be summarised Key performance indicators (KPI). The unstructured information requirements obviously mean that the information requirements cannot be clearly defined. This factor combined with the more complex information needs means that the analytical tools required by these levels of management are more sophisticated. Additionally these levels of management will have need of ‘ad hoc’ queries which will require them to have the capacity to extract the information themselves. The available technologies to provide access to facilitate the extraction of the information include web services, portals and dash boards.
The third perspective of the information architecture is the integrated view which is suitable for information technology personnel and technology confident business people. This view incorporates the elements from both perspectives and also deals with some of the information technology issues.

The use of the information architecture approach allows retailers to establish what data they have, how data flows through the organisation, how the data sources are related and what the information needs of the different levels of management are. Once these are established a suitable Business Intelligence (BI) systems can be deployed. Through the use of the information architecture approach to building and using Business Intelligence (BI) systems grocery retailers can ensure that their various levels of management have the information they require.
6 EVALUATION OF THE INFORMATION ARCHITECTURE

6.1 Introduction

In order to evaluate the information architecture developed, a number of structured interviews were performed. In addition to evaluating the specific information architecture, the concept of developing Business Intelligence (BI) systems through the use of information architectures was also evaluated. The evaluation method involved supplying a copy of the information architecture to a particular relevant party from a grocery retailer and then performing a structured interview with them over the telephone. For each of the three perspectives of the information architecture presented in chapter 5, an appropriate individual was given a copy of the information architecture and then asked to answer a number of questions as per the structured interview presented in appendix B.

6.2 Experimentation

Each of the different perspectives on the information architecture were sent to a relevant party by email. The interviewees were then contacted by phone and asked a number of questions. The individuals interviewed were a store manager, a regional manager and a head of the retail information management systems. The replies to each of the questions were noted and clarity was sought regarding any responses which were ambiguous. Both the store manager and the regional manager were only given their own perspective on the information architecture to evaluate. However the head of the retail information management systems was given all perspectives to evaluate. The reason simply being, that because the head of the retail information management systems has overall responsibility for deploying and maintaining the Business Intelligence (BI) system, they need to know and understand the perspectives of each of the levels of management.
6.3 Evaluation

The first question presented to each of interviewees was ‘What do you understand by the term information architecture? Does your organisation have an information architecture?’ There was considerable confusion over what the term information architecture meant although this is not particularly surprising considering the fact that there is also considerable confusion within the literature as to what the term information architecture actually means. The interviewee who was the head of retail information management systems suggested that it was a ‘blueprint detailing the exact technical features of the system components’. The store manager and the regional manager replied they were not aware of what was meant by the term information architecture but assumed it related to the technical details of computer systems. Neither the store or department manager could offer any further description of what an information architecture was. When asked if an information architecture existed for their organisation the head of the retail management systems replied that they performed a needs analysis and the report from this would contain the same information as an information architecture. It was further indicated that although the head of the retail information management system knew the different types of data that the organisation captured it was not recorded in any document. There appears to exist a cultural issue preventing the documenting and sharing of information which needs to be addressed.

The second question posed in the evaluation interview centred around any advantages the interviewee perceived in the use of information architecture. This question had a number of varying responses. The head of retail information management systems in particular felt that by developing an information architecture, the organisation themselves became clear about information they have, and what information they need. This ensured that management had a realistic expectation of what they could get from the system. In addition it was felt that by presenting the supplier of the Business Intelligence (BI) tools with the information architecture they would get a better understanding of the organisation and what its needs were. Both the store and regional managers were of the opinion that the use of an information architecture helped users understand the organisation’s needs and information flows throughout the organisation. The store manager also observed that the use of an information
architecture helped non technical people understand the issues and elements involved in the deployment and use of a Business Intelligence (BI) system.

The third question posed in the evaluation interview centred on any disadvantages the interviewees perceived in using information architectures for the development and use of Business Intelligence (BI) systems. The only response to this question was made by the head of retail information management systems who was of the opinion that the use of information architectures over simplified the processes involved in a Business Intelligence (BI) system. This response was not surprising as one of the reasons for using an information architecture is to simplify the view of the processes involved, thereby enabling business people to understand the processes. This is a not simplification of the processes just a simplification of how they are viewed. Instead of being a disadvantage this is in fact an advantage. What this response indicated was that to use the information architecture approach requires an element of education and training. Information technology personnel must have a clear understanding of what an information architecture is and what it is used for. The other disadvantage highlighted by the head of retail information management systems was the resources required in the development of the information architecture.

The fourth question evaluated how well the interviewees understood the information architecture. The store manager did not understand some of the terms used in their perspective of the information architecture for example OLAP (online analytical processing). The regional manager and the head of retail information management systems described the information architecture as easy to understand. The fact that the store manager struggled to understand the information architecture highlights one of the uses of the information architecture i.e. a teaching tool. The information architecture can be used to explain the various processes and technologies at use in the retail organisation. This helps the store and department management to understand the applications of the various technologies and be clear upon what information they can extract from their Business Intelligence (BI) system.

The fifth question involved asking the interviewees if they felt any aspects or elements were missing from the information architecture. The head of the retail information management system was the only individual to respond to this question. His response
centred around the addition of technical details concerning each of the various processes and stages in the information architecture. In particular it was suggested that technical details about how the technologies interact should have been included. It was suggested that these technical details should be included in all perspectives of the information architecture. This response to add technical detail clearly indicates that this individual does fully understand the concept of an information architecture. Many of the elements which were suggested were specific technical details about specific Business Intelligence (BI) products. This comment further reinforces the observation that to use the information architecture approach to Business Intelligence (BI) systems will require information technology personnel to have a clear and concise understanding of what an information architecture is and what it can be used for.

The final question in the structured evaluation interview involved ascertaining if the interviewee perceived any potential uses for the information architecture approach in their organisation. The head of the retail information management system noted that it had a number of uses. Primarily it was suggested that it could be presented to the supplier of the Business Intelligence (BI) tools in order to provide them with a understanding of what their requirements and expectations are from the system and what data sources they have available. It was also suggested that it could be used as a tool to explain some of technical jargon and therefore facilitate communication between information technology personnel and business users. The regional manager suggested that it could be used as a tool selection chart. It was suggested that by developing the information architecture, retailers established their requirements from the system, and also they realised what Business Intelligence (BI) tool will fulfil their needs. The regional manager further suggested that the development of the information architecture greatly improved the retailer’s position in negotiations with the suppliers of Business Intelligence (BI) tools. This latter point raises the question of who actually should create the information architecture. Ideally the information architecture should be created by internal staff. This will ensure they fully understand the information architecture and also there is considerable learning in the process of creating it. If the skills do not exist within the organisation to create the information architecture an independent party should be employed. The situation whereby the supplier of the Business Intelligence (BI) tools also creates the information architecture should be avoided as these creates a conflict of interest i.e. it is in the interest of the supplier that
the retailer requires all of the various Business Intelligence (BI) tools which may not be the reality of the situation.

6.4 Learning gained from the evaluation and conclusions

The evaluation of the information architecture took the form of structured interviews with relevant parties. This section presents the learning gained from this evaluation and the conclusions formed. The difficulty with the evaluation was the absence of any tangible metrics to measure the information architecture against. To truly evaluate the information architecture it would be necessary to introduce it into a retail organisation and measure its impact on the information and reports that management received. The findings presented in chapter 4 could be used as baseline data for the measurement of the impact of the introduction of the information architecture. However within the parameters of this research project structured interviews were used as it returned a timely evaluation.

In order for Irish grocery retailers to develop and use the information architecture approach to Business Intelligence (BI) systems there must be education and training provided, this will ensure that parties fully understand the concept of an information architecture. They must understand that an information architecture is used to provide a product independent tool, which provides a mapping showing where the various different types of data are located, the uses and relationships between data sources. This can then be used by the Business Intelligence (BI) system to locate the information it requires and to understand what the information will be used for. By first developing an information architecture retailers gain an in-depth understanding of the information they hold, how it is captured and processed and how it flows throughout the organisation. The use of information architectures will also require a cultural change within organisations requiring information technology personnel to be prepared to understand the organisation and to establish the information needs of the various levels of management.

The advantages and applications of using the information architecture approach to Business Intelligence (BI) systems are evident to all the users of the systems. The advantages include the fact that the management become clear on what exactly they
require from their Business Intelligence (BI). This also has the effect of improving their communications with the supplier of Business Intelligence (BI) tools. The information architectures by their nature provide a simplified view of Business Intelligence (BI) systems.
7 CONCLUSION AND RECOMMENDATIONS

7.1 Introduction

The final chapter of this dissertation presents the conclusions and recommendations formed from performing this research project. The aim of this research was create an information architecture for Irish grocery retailers using or introducing Business Intelligence (BI) system into their organisation. The information architecture was constructed taken into consideration three contributing factors: the retail environment, the various users and the different Business Intelligence (BI) available. This chapter presents a summary of the dissertation in terms of the initial aims and objectives and how these were achieved. In addition this chapter discusses what the contribution to the body of knowledge was and what the potential areas for future research are.

7.2 Research Definition & Research Overview

Due to the intense competition in Irish grocery retail sector many retailers are now turning to Business Intelligence (BI) systems. The objective of these Business Intelligence (BI) systems is to provide the various levels of retail management with information and reports necessary to make effective decisions. Thus Business Intelligence (BI) systems have a pivotal role to play in ensuring the retailer improves its market share or not less hold its market share. Despite this growing dependency on their Business Intelligence (BI) systems most retailers are struggling to get the information they require from these systems, as proved by the findings in chapter 4. This research created an information architecture which facilitates retailers by ensuring they get information they require from their Business Intelligence (BI) systems.

This information architecture was created by taking into consideration the three contributing factors: the retail environment, the users and the different Business Intelligence (BI) tools. The retail environment’s contribution was evaluated through the literature review in chapter 3. The user’s requirements were taken into consideration through literature in chapter 3 and also the finding from the survey analysis. The different Business Intelligence (BI) tools were evaluated in chapter 2.
The survey of the Irish grocery retailers currently using Business Intelligence (BI) had a number of objectives:

- Identify the need for a new approach to the deployment and usage of Business Intelligence (BI) tools.
- Evaluate the information and reports retail management currently receive from their Business Intelligence (BI) systems.
- Establish what the information requirements are of the different levels of retail management.

The following is a list of the objectives that were achieved in this dissertation:

1. A critical review of the latest developments concerning the different Business Intelligence (BI) tools available to Irish grocery retailers was performed. In particular the different application of each of the tools was discussed.
2. A critical review was performed which established the needs of Irish grocery retailers from Business Intelligence (BI) systems. The survey analysis was also used to identify retailer’s needs from Business Intelligence (BI) systems.
3. The current information reports received by retail managers were evaluated. The reports were analysed in terms of their quality, accuracy, timeliness, and relevance to retail management decision making.
4. The various level of retail management information requirements were established in terms of what elements they require in their reports.
5. Using the above critical reviews and building on the analysis an information architecture was developed to facilitate retail organisations in the usage of Business Intelligence (BI) tools.
6. The information architecture was evaluated to establish its usefulness in a commercial setting.

7.3 Contributions to the Body of Knowledge

There primary deliverable and contribution to the body of knowledge at the end of this research project is an information architecture for Irish grocery retailers who are introducing or using Business Intelligence (BI) systems. This information architecture has a number of applications to Irish grocery retailers in particular it may be used:
- By retailers as a blueprint who are introducing Business Intelligence (BI) into a ‘green field site’. In these circumstances it will provide a tool for identifying the scope of the project and a common language to facilitate collaboration concerning the project in particular between technical and non-technical personnel.

- By retailers already using Business Intelligence (BI) systems its provides an architecture which they can compare to own particular design. This will be very beneficial to retailers who are attempting to maximise the information return from their business intelligence systems. It this situation it will provide a tool to allow the organisation compare its current design and layout of Business Intelligence (BI) tools against the architecture to identify gaps.

- For academic purposes it will be useful as a teaching tool and also a source to identify areas of further research. The architecture can be used to provide students with an overview of the different Business Intelligence (BI) available to retailers and how these interact with each other. It may also be used to identify areas which warrant further research. This information architecture provides the foundation for organisations to maximise the return form their Business Intelligence (BI) systems.

In achieving this main contribution to the body of knowledge and number of secondary contributions were achieved including the following:

- A critical review of the various Business Intelligence (BI) tools available to grocery retailers.

- A critical review of the various drivers of Business Intelligence (BI) in the Irish grocery retail sector. Additionally a review of the application of Business Intelligence (BI) in the area of Customer relationship management (CRM) was created.

- A report on how successfully Business Intelligence (BI) systems are currently being used in the Irish grocery retailers. The report evaluated how successful these systems were at getting information to the various levels of retail management. This analysis has identified the fact that retail management are not getting the information they require in order to make effective retail decisions. The findings from the survey analysis can be viewed as baseline data. Future research in the area can compare their findings with this baseline data to investigate if Business Intelligence (BI) systems are being used more successfully in the future.
through the course of this research a survey was created to analyse the use of Business Intelligence (BI) systems in grocery retailers. This survey could used again to re-evaluate Business Intelligence (BI) systems in this sector or adapted to other retail sectors.

- A framework for the creation of information architecture was also created through the completion of this research. This framework had three contributing factors: the retail environment, the users and the different Business Intelligence (BI) tools. This framework could be used to create an information architecture for different retail sectors.

### 7.4 Experimentation, Evaluation and Limitation

One of the most obvious limitation of the research presented in this dissertation is the difficulty in evaluating the deliverable at the end of the research i.e. the information architecture. The method used to evaluate the information architecture was that of a structured interview with individuals who had reviewed the information architecture. This only investigates the individuals interviewed opinion of the information architecture and does not evaluate the usefulness of this information architecture at developing Business Intelligence (BI) systems. In order to thoroughly evaluate the information architecture in a commercial setting it would be necessary to have an organisation adopt the information architecture approach and then evaluate if the information and reports received by the retail management have improved. This would require a piece of longitudinal research which is beyond the parameters of this research project.

### 7.5 Future Work & Research

There are a number of areas highlighted by this work which warrant future research including the following:

- An investigation into the benefits of using information architectures to develop Business Intelligence (BI) systems. The information extracted from the analysis of the survey data could be used as baseline data. Longitudinal research could then be performed after a period of time to evaluate if the use of an information architecture had improved the information and reports delivered to management or not.
Research in the area of metrics regarding Business Intelligence (BI) systems. Further research is required into this area in order to establish a set of metrics which could be used to evaluate Business Intelligence (BI) systems. The development of a set of metrics to evaluate Business Intelligence (BI) in the Irish grocery retail sector would provide a solid foundation on which to evaluate these systems.

This research focused on the Irish grocery retail sector. It would also be useful to perform similar research on different retail sectors to evaluate how their Business Intelligence (BI) systems are performing. If some sectors are successfully operating their systems it would useful to establish what their approach is.

The use of Business Intelligence (BI) tools results in the capture and analysis of large amounts of personal data. This creates a number of ethical and legal issues. Future research in the area may focus on establishing how retailers address these issues and how well do consumers understand how their personal information is processed.

7.6 Conclusion

In order for organisations operating within the Irish grocery sector to survive and prosper they must use Business Intelligence (BI) systems. The current approach to the adoption and use of Business Intelligence (BI) systems is not providing the various levels of management with the information and reports they require in order to make effective decisions. Currently retailers are adopting Business Intelligence (BI) systems and then attempting to get their business processes and information needs to suit the particular Business Intelligence (BI) systems they have adopted. The solution to the problem is in the development and usage of information architectures. By using the information architecture approach organisations develop a full understanding of what data they gather, where the data is stored, what the relationship between the different forms of data is and what the information needs of their management are. Once the organisation has a full and clear understanding of its information architecture it can adopt and modify the various available Business Intelligence (BI) tools to suit its own unique information architecture. If Irish grocery retailers are to use the information architecture approach to building and using their Business Intelligence (BI) systems
they must fully understand the concept of an information architecture. This may require education and training and cultural changes within these organisations.
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APPENDIX A

This appendix contains the survey used to analyse the current use of Business Intelligence (BI) systems in the Irish grocery retail sector. The analyses of the findings are presented in chapter 4.

<table>
<thead>
<tr>
<th>Business Intelligence Survey – Irish Grocery Retailers</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Survey Number:</strong> _______</td>
</tr>
<tr>
<td><strong>Q1</strong> Is your outlet part of a chain: Yes ☐ No ☐</td>
</tr>
<tr>
<td>If yes which chain is your outlet part of ________________</td>
</tr>
<tr>
<td>What is your position in the organisation? ______________</td>
</tr>
<tr>
<td><strong>Q2</strong> Outlet Details</td>
</tr>
<tr>
<td>(a) Square Footage ____________</td>
</tr>
<tr>
<td>(b) Weekly turnover ____________</td>
</tr>
<tr>
<td>(c) Number of full time staff ____________</td>
</tr>
<tr>
<td>(d) Number of part time staff ____________</td>
</tr>
<tr>
<td><strong>Q3</strong> Does your organisation use any of the following technologies:</td>
</tr>
<tr>
<td>Data warehousing ☐</td>
</tr>
<tr>
<td>Data Mining ☐</td>
</tr>
<tr>
<td>OLAP ☐</td>
</tr>
<tr>
<td>GIS ☐</td>
</tr>
<tr>
<td>ePOS ☐</td>
</tr>
<tr>
<td><strong>Q4</strong> Which, if any, of the following have been carried out for your outlet the past 12 months:</td>
</tr>
<tr>
<td>Customer Satisfaction survey ☐</td>
</tr>
<tr>
<td>Customer panel ☐</td>
</tr>
<tr>
<td>Focus group ☐</td>
</tr>
<tr>
<td>Mystery shopper report ☐</td>
</tr>
<tr>
<td>Any other information finding exercise ☐</td>
</tr>
</tbody>
</table>
Q5  Does your organisation use loyalty cards?

Yes  No

☐  ☐

Q6  Is there a fixed reporting structure in your organisation in terms of:

How often do you receive reports

Yes  No

☐  ☐

If yes, how often do you receive reports

Is there a fixed structure to the reports

Yes  No

☐  ☐

Q7  Please rate how satisfied you are with the information/reports you receive.

Extremely Dissatisfied  Dissatisfied  Indifferent  Satisfied  Extremely Satisfied

1  2  3  4  5

Q8  Would you describe the information you receive as:

Valuable information for retail management  ☐

Interesting but of no use to management  ☐

Useful but missing some important elements  ☐

Makes no difference  ☐

Good, but out of date  ☐

Irrelevant  ☐

Q9  What are the major elements contained within the reports you receive. Please list below

1

2

3

4
Q10 Please list any changes you would make to the information/reports you receive.

Q11 Please rate how well the information is presented in terms of how easy it is to understand

Difficult to understand       Easily understood

1     2     3     4     5

Q12 Are you capable of extracting your own reports from the RIMS/ePOS system

Yes  No

☐  ☐

Q13 Have you any other comments to add about the reports/information you receive
Q14  Please rate the **importance** of the following pieces of information to retail management (please circle)

*Please do not rate the following on how well your organisation performs on them*

<table>
<thead>
<tr>
<th>Extremely Important</th>
<th>Unimportant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowing customer profiles</td>
<td>1 2 3 4 5 6</td>
</tr>
<tr>
<td>Knowing who their valuable customers are</td>
<td>1 2 3 4 5 6</td>
</tr>
<tr>
<td>Success of promotions</td>
<td>1 2 3 4 5 6</td>
</tr>
<tr>
<td>Average spend of customers</td>
<td>1 2 3 4 5 6</td>
</tr>
<tr>
<td>Knowing sales by time</td>
<td>1 2 3 4 5 6</td>
</tr>
<tr>
<td>Knowing sales by department</td>
<td>1 2 3 4 5 6</td>
</tr>
<tr>
<td>Knowing sales by product</td>
<td>1 2 3 4 5 6</td>
</tr>
<tr>
<td>Customer’s opinion of product range</td>
<td>1 2 3 4 5 6</td>
</tr>
<tr>
<td>Customer’s opinion of staff friendliness</td>
<td>1 2 3 4 5 6</td>
</tr>
<tr>
<td>Customer’s opinion of value of money</td>
<td>1 2 3 4 5 6</td>
</tr>
<tr>
<td>Customer’s opinion of parking facilities</td>
<td>1 2 3 4 5 6</td>
</tr>
<tr>
<td>Customer’s opinion of parking facilities</td>
<td>1 2 3 4 5 6</td>
</tr>
<tr>
<td>Customer’s opinion of opening hours</td>
<td>1 2 3 4 5 6</td>
</tr>
<tr>
<td>Sales by department</td>
<td>1 2 3 4 5 6</td>
</tr>
<tr>
<td>Sales by product</td>
<td>1 2 3 4 5 6</td>
</tr>
<tr>
<td>Sales by time</td>
<td>1 2 3 4 5 6</td>
</tr>
</tbody>
</table>

Q15  Are you aware of your outlet’s:

(a) Most valuable customers

☐ If yes because of Experience Reports

104
(b) Success of promotions  If yes because of Experience Reports

(c) Average spend of customers  If yes because of Experience Reports

(d) Customer profiles  If yes because of Experience Reports

Q16 Are you aware of your customer’s opinion of

(a) Product range  If yes because of Experience Reports

(b) Staff friendliness  If yes because of Experience Reports

(c) Value for money  If yes because of Experience Reports

(d) Parking facilities  If yes because of Experience Reports

(e) Store layout  If yes because of Experience Reports

(f) Opening hours  If yes because of Experience Reports

(g) Sales by department  If yes because of Experience Reports

(h) Sales by product  If yes because of Experience Reports

(i) Sales by time  If yes because of Experience Reports
Q17 Please list in order of importance the elements you consider essential to include in a monthly, six monthly and annual report:

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
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<td></td>
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<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

THANK YOU
APPENDIX B

This appendix contains a copy of the structured interview used to evaluate the information architecture. The results of the evaluation are presented in chapter 6.

**Information architecture – evaluation interview**

_Interviewee position:_

Q1 What do you understand by the term information architecture? Does your organisation have an information architecture?

Q2 After viewing the information architecture do you think there are any advantages to developing and using an information architecture to help in the deployment and development of Business Intelligence (BI) systems.

Q3 After viewing the information architecture do you think there are any disadvantages to developing and using an information architecture to help in the deployment and development of Business Intelligence (BI) systems.
Q4 Do you understand the information architecture?

Q5 In your opinion are there aspects of the Information architecture missing.

Q6 Do you envisage any uses or potential uses for an Information architecture within your organisation. If so what are they?
APPENDIX C

Screen shots from Statistical package for social science (SPSS) version 14 of the variables defined to analyse the survey data.

```
<table>
<thead>
<tr>
<th>Name</th>
<th>Type</th>
<th>Width</th>
<th>Decimals</th>
<th>Label</th>
<th>Values</th>
<th>Missing</th>
<th>Columns</th>
<th>Align</th>
<th>Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td>SurveyNo</td>
<td>Numeric</td>
<td>8</td>
<td>2</td>
<td>Survey No</td>
<td>None</td>
<td>None</td>
<td>8</td>
<td>Right</td>
<td>Scale</td>
</tr>
<tr>
<td>Q1a</td>
<td>Numeric</td>
<td>8</td>
<td>2</td>
<td>Part of Chain</td>
<td>None</td>
<td>None</td>
<td>8</td>
<td>Right</td>
<td>Scale</td>
</tr>
<tr>
<td>Q1b</td>
<td>String</td>
<td>18</td>
<td>0</td>
<td>If Yes, What chain</td>
<td>None</td>
<td>None</td>
<td>8</td>
<td>Left</td>
<td>Nominal</td>
</tr>
<tr>
<td>Q1c</td>
<td>String</td>
<td>23</td>
<td>0</td>
<td>What is your position</td>
<td>None</td>
<td>None</td>
<td>19</td>
<td>Left</td>
<td>Nominal</td>
</tr>
<tr>
<td>Q2a</td>
<td>Numeric</td>
<td>6</td>
<td>2</td>
<td>Square Footage</td>
<td>None</td>
<td>None</td>
<td>8</td>
<td>Right</td>
<td>Scale</td>
</tr>
<tr>
<td>Q2b</td>
<td>Numeric</td>
<td>8</td>
<td>2</td>
<td>Weekly turnover</td>
<td>None</td>
<td>None</td>
<td>8</td>
<td>Right</td>
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