Evaluation of Business Intelligence Maturity Level in Iranian Banking Industry

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ABSTRACT

Business intelligence (BI) is a managerial concept which helps managers in the organizations to manage information and make factual decisions. Some have introduced Business Intelligence as a process of turning data into information and then into knowledge. This concept has become a popular trend for businesses interested in adding value to their decision making processes.(Golfarelli et al., 2004) In addition measurement of Business Intelligence readiness/maturity is considered a critical issue.

Business intelligence like software development is a process, which expressed in terms of components such as artifacts and workflows. In software engineering, the Capability Maturity Model Integrated (CMMI) developed to define different levels of software process maturity. We draw upon the concepts underlying CMMI to define different maturity levels for a business intelligence process.

The study examines the maturity level of Business Intelligence activities as well as the future outlook concerning Business Intelligence in the Iranian banks. The research will also examine key areas of improvement in Business Intelligence operations, benefits gained from Business Intelligence as well as the strength point of Iranian banking industry in using Business Intelligence.

Further, a model for business intelligence chose with the factors influencing business intelligence. Then, the questionnaire designed based on CMMI process for testing business intelligence process. Totally 99 valid questionnaire where gathered and by means of factor analysis methods both data and model were evaluated. In addition, the regression tests done in order to test the ability of model. Furthermore, the level of maturity of Iranian banking organization measured and introduced. Finally, the research limitations and some recommendation for further researches offered.

Keywords: Business Intelligence, maturity level, capability maturity model integrated, maturity models, banking industry, business intelligence measurement, business intelligence process.

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List of Abbreviations

BI: Business Intelligence

CMM: Capability maturity model

CMMI: Capability maturity model Integration

ETL: Extract, Transform, Load

OLAP: On-Line Analytical Processing

OLTP: On-Line Transaction Processing

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Chapter 1

Introduction

Introduction

This chapter will introduce the subject of the research. Starting with the managerial dilemma, the dilemma will followed by the problem statement and importance of the study.

1.1 *Managerial dilemma*

In today world managers need more accurate and more private information, they want the information on time in order to make effective decisions, so the existing information flow cannot meet the needs of managers. With the existed systems they were not able to make fast decisions and evaluate large amounts of data that may be stored in different locations. Business intelligence technology is the solution for this problem of managers.

In order to improve business operations, organizations are being forced to gather, understand, and harness their data to make practical decision. Conversely, some regulation and rulings as well as legislation, has obliged business leaders to make their business processes into document and sign off on the legitimacy of the information they trust in and report them to stakeholders. Moreover, faster and more informed and efficient decision making is a competitive crucial because business cycle time is extremely condensed (Turban et al., 2008).

In addition, in Iranian organization, especially the banking industry there is a huge amount of data, which should be used for different applications; Iranian managers are not familiar with BI process. Managers need the right information at the right time and the right place.

1.2 *Problem statement*

The role of Data is critical in most companies, but there are some industries that need data more quickly and more accurately to analyze very large amounts of data from different sources. Some up to date manufacturing factories generate and store huge amounts of data, some of them are from ERP (enterprise resource planning) systems and other from transaction-based systems. During the process of production of different items, various systems pile up and analyze data.

Stock levels; deliverance schedules; customer commands; prices paid; product return rates; and product development are some examples for different data sources. In order to answering accurately to questions like, how will a 5 per cent fall in production of a particular product in a specific month affect company profits? And who are most profitable customers, we need to have an integrated system, a system which connects

various data sources. This system should make different sources to communicate with each other. (Dobbs et al., 2002)

Today we need to have enough information about inside and outside of our company, we should monitor every situation and for such monitoring, we should have Business Intelligence tools. Applying business intelligence tools helps our decision making.

In any organization data is available and, these data can be the focal source for CEOs to make decisions.

'IBM incorporation reported that over 93% of corporate data is not usable in the business decision-making process today.' (Reinschmidt and Allison, 2000)

The problem stated in this research is that Iranian banking industry have a big amount of data, but they do not have the ability to convert these data to information, because they are not enough familiar with business intelligence. The Iranian banks have different systems for analyzing data but they are not integrated.

In addition, they do not know how they use business intelligence tools and in which levels of implementing BI they are in. because they have no framework to measure the uses of business intelligence.

1.3 *Research questions*

The research questions of this research are as follows.

1. What is the maturity level of BI processes in Iranian banking industry?
2. What are the most important areas of improvement and strengths of BI processes in Iranian banking industry?

1.4 *Importance of the study*

For so many years business managers collected and stored huge amount of data in order to obtain some valuable outcome. There is a well-liked statement; “The answer to my problem is hidden in my data... but I cannot dig it up!” This has been around for many years. Nevertheless business managers finally discovered that unprocessed data doesn't have sufficient benefit for making decision, and that their actual value depends on

an organization's ability to analyze those data. Therefore the needs for software systems which are equipped to recover, abbreviate, and understand data emerged for end-users.

This need stimulated the emergence of many of business intelligence companies that are specialized in providing software systems and services for digging up knowledge from raw data. These software systems would analyze a company's operational data and provide knowledge in the form of tables, graphs, pies, charts, and other statistics. (Michalewicz et al., 2007)

Based on the various uses and obvious potential of Business Intelligence, it would be normally assumed that firms of all types would be eager to adopt and implement appropriate systems. Reedy added that there is no doubt that with better and higher quality information organizations will have higher confidence in decision making in all practical areas. (Reedy, 2001)

Some mentioned popular uses of BI as, helping organizations to understand their opportunities in growth of sales and profit, business intelligence make them the possibility to identify customer's buying patterns. With implementing business intelligence organizations can progress their overall decision making. They believe that with accurate, real-time data we will be able to mark and fix situations before they become problems and potentially extend out of control. Considerably, Business Intelligence analyzers argue that immediate data are also fundamental for companies that wish to grab new opportunities rapidly or adapt when customer response to a promotion exceeds expectations. Essentially, Business Intelligence solutions make the companies able to extract, cleanse, and aggregate data from operational tools into a separate data mart or warehouse. Inmons add that the value of Business Intelligence is giving the competitive advantage to different companies. Davis say that the masters of Business Intelligence are Japanese. He also mentioned that Business Intelligence as an innovation is a rightful business function and that it is particularly precious in achieving information about rivals. He quoted that it was noted in 1996 that it is particularly useful for predicting the future situation in which a company will function.

Inmon also refer to The Montague Institute Review in the paper, it is said that Business Intelligence is a valuable tool for dealing with and understanding competition. In this paper they also go to Weiss that is principally eager about the value of Business Intelligence systems for the complete strategic scheduling process. Finally, Smith predicts an extensive augment in the usage of Business Intelligence systems so that companies

might be a sign on their experiences to date before taking some new course of action .(Inmon, 2002 ;cited by Rivest et al,2005)

Reinschmidt believes in data increasing, he said that the quantity of business data is increasing exponentially. Indeed, the amount of data doubles every two to three years. Obtaining more information in organization means more competition. In the era of the information blast, decision-makers, managers, professionals, and workers all need to be able to make better decisions more rapidly. Because in this time, information is precious more than ever (Reinschmidt, 2000)

Dobbs have done a case study research in the UK firms in order to investigate UK data warehouse and business intelligence implementation. According to this case study, he noted that, the amount of data collected by most UK firms is increasing rapidly. This rapid increase is creating a need for businesses to use tools to monitor the data, break down it and of course, understand it. He considers Users of the resulting information as managers at different levels as well as analysts and, gradually less important staff whose job requires them to understand specifically what is happening in one part of the business. At all levels, staff needs precise information in a form, which can be easily understood and quickly acted. In the past, many kinds of decisions would have been made without either investigation or using outdated information. (Tony Dobbs, 2002)

The Iranian banks suffer from the same problem. Rouibah explains Business intelligence (BI) as a strategic approach for scientifically marking, tracking, communicating and transforming appropriate weak signs into actionable information on which strategic decision-making is based. He believes despite the growing importance of BI, there have been done little scholastic work, which directly can lead to the understanding of indistinct weak signs. (Rouibah and Ould-ali, 2002)

According the Konrad, the organizations should know their position and based on that they should make decision to make improvements. He adds that this is where CMMI (Capability Maturity Model Integration) appears. If you do not know, where you are and where you need to go, change will never lead to substantial improvement. (Chrissis et al., 2006)

To conclude, the vast amount of data technology in organizations, cause the need to understand the factors how to use these data, and also understanding BI ,and having a framework to make organizational progress in field of implementing business intelligence.

In services companies which their business is finance, service procedures and customer information are considered as a critical tool. Retail banks and insurance companies usually have lots of customers, and they have huge amount of data, It is not easy for them to forecast how changes in areas such as consumer behavior, market performance and government strategy will influence their business. In order to profit from all the data they have collected and stored, these companies need to:

- extract the data from different and various sources;
- transform it into a steady format;
- pack it into a data warehouse;
- analyze the data and making decision based on them

Throughout the Middle East, there is a desire to modernize banking systems in order to create an infrastructure to support a financial industry. From hatchling stock exchanges to overhauling 10-year old computing systems, modernization is moving at a rapid pace. Iran is no exception, and leading financial technology consultants currently courted it for contracts. So the bank experts should become more familiar to business intelligence process and its tools.

1.5 *Limitation of the Study*

BI as a whole has not introduced well in Iran specially in banking industry. Therefore, there is different points of view and perception, which could alter the results of this research.

The other limitation was about the questionnaires. Some of the responders did not filled the questionnaires well, because of some reasons like secrecy of information or not being interested in this issue or not being familiar with.

1.6 *Research approach*

Regarding the vast amount of data in Iranian banks, they should have BI tools to extract information from data and convert that information to a knowledge, which they can use in their business. Moreover, they should know their position in the levels of maturity.

Working with one Iranian bank, showed the lack of BI tools in the industry, tools for extracting, cleansing and transforming data. In addition, tools for monitoring the company. There are not any practical databases. The managers of the banks do not even know what BI process is and what its tools are.

The CMMI provides a good framework for organizational improvement. It allows companies to prioritize their process improvement initiatives. At the beginning of this research, the researcher wanted to know the way to extracting useful data and using these data to making best decisions. Moreover, wondered how technology can help managers to monitor their environment and make decision for future.

At the second step, after studying some articles and reviewing literatures, the researcher became familiar with great world of Business Intelligence. Following the research in the field of BI, it is found that BI is a process and becoming familiar with its tools and a model for testing the maturity level of implementing BI. BI definition and benefits will be investigated and the view of BI is very important to ask from managers, and the workers in the companies.

As mentioned before, the first step of this research will be more focusing on business intelligence concept and tools in Iranian banks. Then testing the model extracted from literature.

Moreover, after a complete focusing on literature the research goes toward defining CMMI for business intelligence process, and for this purpose, for testing the maturity levels of implementing BI, the survey done to illustrate the maturity levels of organizations.

The next step of the research will be some studies in Iranian companies (the focus will be banking industry), to understanding how they use BI. In addition, the last phase of research will be positioning Iranian companies in the maturity level, which would have been found.

1.7 Background for research

Current literature on Business Intelligence has been fairly imprecise and theoretical. There has not been a generally settled commencement of Business Intelligence but, rather, each author has promoted his or her own idea of its connotations.

In recent years, Business some researchers have done in case of evaluation the business intelligence. One of these researches is ‘Business intelligence empirical study on the top 50 Finnish companies’ which has been done by (M.Hannula and V.Pirttimaki, 2003).

Another research in this field is ‘Influence of Business Intelligence Implementation to the Banks’ Performance:

Case study of Croatian Banking Sector’ written by (M. Pejić Bach et. al) and the one which was the main source of this study is the SPEKs project which is Report concerning Companies’ needs for BI Tools and Systems. This research has been done in different European countries in 2005.

1.8 *Research objectives*

Business Intelligence activities have recently become much more common in Iran. There have not been studies researching Business Intelligence from a practical viewpoint in this country and, therefore, the objective of this study was to find out

- how common the Business Intelligence activities are and
- How Business Intelligence is currently being applied in Iranian banks.

The study examines the maturity level of Business Intelligence activities as well as the future prospects concerning Business Intelligence in the interviewed companies. The research will also examine key areas of improvement in Business Intelligence operations, benefits gained from Business Intelligence as well as the strength point of Iranian banking industry in BI.

Chapter 2

Literature review

Introduction

In this chapter, the fundamental concepts will be explained, such as Business Intelligence and the Capability Maturity Model for evaluating the maturity level of BI process. Then the model that is going to be focus of this research will be introduced.

2.1- What is BI

Turban explains Business Intelligence as the new approaches in which companies collect, organize and apply information. He believes the old ways have been changed to reflect new and go-ahead technologies, because the companies need to make real time decisions based on their data. He adds that a Business Intelligence (BI) system is a technology that provides insignificant business value by improving the usefulness of managerial decision-making. Today in a suspicious and highly competitive business situation, the value of strategic information systems is easily recognized. High adoption rates and investment in BI software and services suggest that these systems are a principal provider of decision support in the current marketplace.

Turban defines Business Intelligence as an umbrella, which includes architectures, tools, databases, applications, and methodologies. And he mention main objective of Business Intelligence as enabling interactive access to data, enabling exploitation to that data and providing managers and analysts to use that data.,(Turban et al., 2007)

Cooper suggests that effective business decisions depend on the acquirement, processing and utilization of applicable knowledge. He believes some information or knowledge is basically more valuable and more sensitive than other information. He views the area of BI as a complex one and really exploding the often-held view that it is some kind of update of a modern business database. (Hill and Scott, 2004)

Brackett states that intelligence is the ability to learn, to understand or to deal with new or demanding situations; in his view intelligence is the experienced use of reason as well as the capability to use knowledge to control one's environment or to think theoretically. He adds that BI is a set of perceptions, methods and processes to improve business decisions, using information from multiple sources, applying experience, and adding hypothesizes to develop an accurate understanding of business dynamics. He concluded that business intelligence is about collecting, managing and analysis of data in order to generate information which is allocated to people throughout the organization to progress the strategic and planned decision-making. Finally he explained BI as a process which engages the combination of core information with relevant appropriate information to perceive important events and clarify unclear subjects for management decision-makers. This conclusion consists of the capability to observe business tendencies,

including and adapting quickly in the time that situations change. As well as generating intelligence decisions in business situations which are uncertain and making decision is difficult. In other view he adds that BI relies on investigation and analysis of unrelated information to provide relevant insights, identifying trends and discovering opportunities. In his explanation usefulness of business intelligence depends on high quality information. This can only be derived from a high-quality data resource.

The existence of different and disparate data sources in most industries which implementing business intelligence is useful in them, has been raised the concept of cleansing data and linking these different sources and also making access to them in a meaningful approach. (Hill & Scott, 2004)

Reinschmidt believes that Business intelligence is not business as common he considers BI as an easier and more quickly decision making process. There are huge amount of collected data in every businesses, they collect daily information from different sources; orders, inventory, accounts information and information of point-of-sale transactions, and of course, customers. Businesses also obtain demographic data and from external sources. In this situation and with this load of data finding a new way for combining and organizing data for better business decisions can direct to a competitive advantage, and learning to encounter and control those advantages is what business intelligence is all about. (Reinschmidt, 2000)

Herschel & Jones consider Business intelligence as a tool for making better decisions, they quote that "Gartner consultancy clarifies this by explaining BI as set of all technologies that gather and analyze data to improve decision making". They add this concept that business intelligence is the detection and clarification of concealed, innate and decision-relevant contexts in large amounts of business and economic data. (Herschel & Jones, 2005)

Herschel & Jones state that Cook and Cook assert that the attraction of BI is that it offers organizations quick and Powerful tools to store, retrieve, model, and analyze large amounts of information about their operations, and in some cases, information from external sources. Dealers of business Intelligence applications have helped other companies and organizations raise the value of the information that exists in their databases. Firms can control and monitor many aspects of their business operation by applying the analysis functions of BI, they also can classify factors that are influencing their performance. (Herschel & Jones, 2005)

the most important benefit of using BI and its main objective is in decision making as Sonia Rivest in her paper mentioned; there are systems that have been developed to help decision making and called 'analytical systems, they are known as Business Intelligence solutions.(Inmon, 2002 ;cited by Rivest et al., 2005)

Gartner consultancy explains BI as set of all technologies that gather and analyze data to improve decision-making. In BI, intelligence is often defined as the discovery and explanation of hidden, inherent and decision-relevant contexts in large amounts of business and economic data. (Herschel and Jones, 2005)

Dobbes explains the different data sources which have been gathered and warehoused in the companies should be extracted from all various sources, be transformed into consistent formats and loaded and deposited in data warehouses and analyzed in order to gain useful decisions, to be efficient for the companies.

With this kind of benefits companies can make better business decisions more quickly than their competitors do. (Classically, this involves using business intelligence software, ranging from advanced reporting groups to statistical packages. (Dobbs et al, 2002)

Businesses face some challenges today; challenges such as globalization of markets, customers which are more informed and demanding, augmented bargaining power of suppliers, strategic competitors and evolving technologies. With these kinds of challenges and in such competitive business World, business need to always keep an eye on what is happening in the industry in order to be succeeded. This would allow them to make decisions to react and alter quickly to the changes in the business environment before it is too late. Gilad describe the term business intelligence, also as competitive intelligence, commercial intelligence or corporate intelligence. These terms are used to express the process of monitoring a firm's external environment to gain information relevant to its decision-making process (Gilad & Gilad, 1988; cited by chau et al, 2006).

The business intelligence guru, Ralph Kimball defines business intelligence as “a generic term to describe leveraging the organization's information assets for making better business decisions”. Business intelligence bring about the gathering of data from internal and external data sources, as well as the storing and analysis thereof to make it accessible to assist in better decision-making (Wikipedia, 2006; cited by Dyk and Conradie, 2007).

As Green indicated, a business has eight value drivers that arrange its framework (figure 2-1). She added that the key to capturing business information is to ask the right questions and to know what is needed to answer the questions. Every one of these value drivers initiates main questions that side with performance. This archaic layer of business information then places the business to construct intelligence.

Figure 2-1 .Aligning capacity drivers with business operations

Source: (Green,2007)

Some explain Business Intelligence with different approach, one of these approaches explained by Green. She believes Business intelligence is decomposed into business information and is not a single entity. Cross-pollination of the value drivers identifies three major components to business intelligence within a business enterprise.

Green asset these three components as; Relationship Intelligence, Competence Intelligence and Structure Intelligence.

- Relationship Intelligence recognizes of how the relations between knowledge workers influence the organizational performance.
- Competence Intelligence recognizes of how the abilities/proficiency of knowledge workers influences organizational performance.
- Structure Intelligence recognizes of how the organization's Infrastructure environment influences organizational performance. (Green, 2007)

Table 2-١ .Business Intelligence, three major components

Relationship intelligence

1. Employee-to-Employee Relationships
2. Employee-to-Customer Relationships
3. Employee-to-Competitor Relationships
4. Employee-to-Partners Relationships
5. Customer-to-Customer Relationships
6. Customer-to-Competitor Relationships
7. Customer-to-Partners Relationships
8. Competitor-to-Competitor Relationships
9. Competitor-to-Partner Relationships
10. Partners-to-Partners Relationships

Competence intelligences

1. Employee-to-Information Competencies
2. Employee-to-Process Competencies
3. Employee-to-Product/Service Competencies
4. Employee-to-Technology Competencies
5. Partners-to-Information Competencies
6. Partners-to-Process Competencies
7. Partners-to-Product/Service Competencies
8. Partners-to-Technology Competencies

Structure intelligence

1. Customer-to-Information Structure
 2. Customer-to-Process Structure
 3. Customer-to-Product/Service Structure
 4. Customer-to-Technology Structure
 5. Competitor-to-Information Structure
 6. Competitor-to-Process Structure
 7. Competitor-to-Product/Service Structure
 8. Competitor-to-Technology Structure
 9. Information-to-Information Structure
 10. Information-to-Process Structure
 11. Information-to-Product/Service Structure
 12. Information-to-Technology Structure
 13. Process-to-Process Structure
 14. Process-to-Product/Service Structure
 15. Process-to-Technology Structure
 16. Product/Service-to-Product/Service Structure
 17. Product/Service-to-Technology Structure
 18. Technology-to-Technology Structure
-

Source: (Green,2007)

Chou stated that organizations are turning to BI tools more because they want to rationalize their return on investment (ROI). In his view BI tools collect data by ERP, customer relationship management (CRM), and other data-intensive. BI systems can draw the data in ERP systems and then execute various analyses and deliver advanced reporting, which help users make timely and accurate decisions.

He adds that BI tools are competent of analyzing the long and the short-term business scenarios; this could be happen by using accessible data confined from the enterprise information systems. BI technology can be utilized for any organization to configuration the information in ERP systems and other data repositories such as data warehouses and data marts for achieving optimized and effective decision-making. Many companies have to rely on a single source of information (i.e. the transactional systems) to run their daily operations. However, these transactional systems do not meet management's need to discover trends and patterns that can be consequent from their inbuilt business rules. (Chou et al, 2005)

Rasmussen believes that companies need effective BI tools for better decision-making. He say that from the past times organizations have spent too much time for preparing data and financial reports, but they spent too little time on analysis the data. This kind of time allocating made a detachment between the analysis and review process and action (figure 2-2) (Rasmussen et al., 2002)

Chou considers BI process as a competitive advantage for a company in today's competitive marketplace. The knowledge and information about the customers, dealers, partners, products, and market will consent to wise decision-making in the company that may result in noticeably revenue increase, cost diminution and profit augmentation. Apart from conservative reporting tools such as spreadsheets, BI reporting tools provide a visual interface for admittance and navigating through multidimensional data sources that stored in transactional systems. This signifies that decision makers and analysts will have easier and quicker access to repeatedly updated information, which supports quicker and better decision-making. Finally he concluded that a commanding BI tool can generate different views from available data system. A scaled data mart or data warehouse can provide well-off, timely, and well-structured and rinsed information to the BI tool. It needs only a few seconds to use BI software to generate requested views of the business. (Chou et al., 2005)

Figure 2-۲ .Why Business Intelligence solutions are needed

Source: (rasmussen et al,2007)

Rasmussen introduces Business Intelligence as a tool for investigating weak signs. He explains that because companies are growing in tumultuous and ambiguous environments, they need to be watchful and attentive for the uncovering of weak signals and discontinuities about emerging hazards and opportunities and to commence further probing based on such detection. In such environments, business intelligence (BI) is developing to contend with the large volume of information available but often ambiguous, inaccurate and inconvenient. The main crucial question raised by companies in such environments is how to take advantage of this information to seize opportunities, and evade surprises when discontinuities occur (Grove, 1999; Moore and McKenna, 1999; cited by Rasmussen et al., 2002).

William A. Giovinazzo in his book ' Internet-Enabled Business Intelligence' noted that business intelligence is all about thinking. BI is thinking theoretically about the organization, analysis of the business, and organizing large quantities of information about the business environment. He adds development of a strategy requires that the decision maker acquire a set of essentials and create something new. And he considers it

as the real meaning of BI. The pure size of most organizations, however, requires that there to be an information infrastructure present to make easy this level of intelligent thought. He believes that organizations need BI in order to continue to exist; in this competitive world the organizations need to develop a endearing strategy and in order to develop such strategy they must be able to be hopeful of future conditions. For anticipating the future, they need the preceding information. by using BI they can use precedent information for making useful decisions. (Giovinazzo, 2002)

Figure 2-۳ . BI systems as holistic information technology infrastructure that supports decision-making

Source: (Olszak& Ziemba, 2006)

2.2- BI history

Chou explain that BI at first introduced by Howard Dresner from Gartner Group in 1989. He described a set of concepts and methodologies which have been designed to progress decision-making in business with facts and fact-based systems (Hashmi, 2004; cited by Chou et al., 2005). He described Fact-based systems as managerial information systems, decision support systems, activity information systems, management support systems, OLAP, and newer technologies such as data mining, data visualization, and geographical information systems. (Chou et al., 2005)

2.3- BI Milestones

Biere, bullets milestones of Business Intelligence as follow;

- "Untimely with establishing the impression of end-user computing, user-friendly languages emerged to present a link between end users and the hostile IT environment."
- "The want for putting standards for corporate analysis tools was one of the most significant benefits from the Centralized centers of competency. These centers were built to provide a means for end users to become productive quickly "
- "With the period of client/server, systems came the understanding that keeping data may not be beneficial to analysis; consequently, reengineering of data into BI-friendly forms and formats was ideal. The most commonly accepted form of database was a relational store that supported SQL. The need to establish and stick to standards for all SQL dealers became a mantra."
- "The Information Warehouse verified that admittance data in place is not always enviable, but capturing the metadata about existing information makes wonderful sense. Before we convert current information, we need to know all we can about its current contents and form."
- "Data warehousing projects brought all the relevant steps together for taking accessible information sources and creating innovative, analysis-based data. It also proved that the tasks related to data conversion could be extremely long and costly. The argument as to whether a warehouse or a mart is more suitable continues. The most considerable aspect of warehousing is the understanding that the back ends will probably remain and processes to transform and create new data stores must be computerized. These are not one-time events."
- "We are come into a period where packaged BI solutions are wanted. One motivating force behind these is the need to transport sophisticated metrics and analyses to top management."(biere, 2003)

Rasmussen et al indicated that the investigative software packages started emerging in the market in the 1970s and 1980s.

But be deficient in computing ability and not sufficient user friendliness, and awkward and manual integration with the transaction systems providing the data made BI tools not to be used widely.

(figure4) (Rasmussen et al, 2002)

Figure 2-۴ .evolution from static reports to business intelligence

Source: (Rasmussen et al, 2007)

2.4- BI tools

Business Intelligence has different tools; BI tools can be used to produce various aspects of business views through controlling existing data captured by company's information systems.

Cody stated that BI accomplishes decision making by utilizing data warehousing and online analytical processing techniques (OLAP). He explains Data warehousing as a process of collecting relevant data into a repository, where it is arranged and authorized so it can serve decision-making objectives.

The various sorts of the business data are pull out, transformed and loaded from the transactional systems into the data warehouse. An important part of data warehouse's process is data cleansing where variations in data schemas and data values from disparate transactional systems are determined.

He adds that In the data warehouse, a multidimensional model can be created which supports stretchy drill down and roll-up analyses he clarify roll-up analyses in this way, it creates progressively higher-level subtotals, moving from right to left through the list of grouping columns. Finally, it creates a grand total.. Tools from various vendors provide end users with a different query and front end to the data warehouse. Large data warehouses can hold tens of terabytes of data, whereas smaller, problem-specific ones often hold 10 to 100 gigabytes (Cody et al., 2002; cited by Herschel and Jones, 2005).

Azvine introduce usual features of BI software as:

- Reporting and visualization, trend analysis (historical and emerging),
- Customer behavior analysis,
- Predictive modeling (analyze most likely future Scenarios).

He indicates that BI requires three main categories of technology —data warehouses, analytical tools, and reporting tools. He explains Data warehouses as a tool for gathering data from incongruent sources which could be databases and unstructured text, and integrate them for further analysis. The analytical tools in his view can be, for example, data mining tools. They analyze data and derive insights. Visualization and reporting tools create outputs that are designed for the information consumer who is typically a business user and not an analyst. These tools generate reports and dashboards with different degrees of detail and sometimes drilldown capabilities. (azvine et al., 2005)

Micro strategy defines styles of BI as follows:

"1. **Enterprise Reporting** – Report writers were used to generate highly formatted static reports predetermined for broad division to many people.

2. **Cube Analysis** – Cube-based BI tools were used to supply straightforward slice-and-dice analytical capabilities to business managers.

3. **Ad Hoc Query and Analysis** – Relational OLAP tools were used to permit power users to query the database for any answer, slice-and-dice the entire database and surf down to the lowest level of transactional information.

4. **Statistical Analysis and Data Mining** – Statistical and data mining tools were used to perform predictive modeling or to discover the cause-and-effect correlation between two metrics.

5. **Report Delivery and Alerting** – Report Distribution engines were used to send full reports or alerts to large user populations based on contributions, schedules or threshold events in the databases." (Micro strategy, 2002)

Chou stated in his paper that The BI tools play a major role of enhancement of the quality of decision-making. Businesses need to center on their BI activities in the areas of cost reduction, profitability analysis, product or service usage analysis, target marketing, relationship marketing, and CRM in order to make their business more competitive. (Chou et al., 2005)

2.5- BI applications

Hard works have been done to progress BI systems have and such efforts have been ended to emergence of different BI solutions.

Olszak and Ziemba in the paper indicated that the most important business effects are achieved while using the following analyses offered by the BI systems:

- Cross selling and up selling analysis
- Customer segmentation and profiling analysis;
- Analysis of parameters significance;
- Endurance time analysis;
- Analysis of customer loyalty and customer churn;
- credit scoring;
- Fraud detection;
- Logistics optimizations;

- forecasting of strategic business processes development;
- web mining (analysis and assessment of the Internet services performance); and
- Web farming is analysis of the Internet content. (Olszak and Ziemba, 2006)

Table 2-۲ .Business Intelligence application areas

BI applications	Objectives
Retail industry	<ul style="list-style-type: none"> • Forecasting. Using scanning data to forecast demand and based on the forecast, to define inventory requirements more accurately • Ordering and replenishment. Using information to make faster decisions about items to order and to determine optimum quantities • Marketing. Providing analyses of customer transactions (what is selling, who is buying) • Merchandising. Defining the right merchandise for the market at any point in time, planning store level, refine inventory • Distribution and logistics. Helping distribution centres manage increased volumes. Can use advance shipment information to schedule and consolidate inbound and outbound freight • Transportation management. Developing optimal load consolidation plans and routing schedules • Inventory planning. Helping identify the inventory needed level, ensure a given grade of service
Insurance	<ul style="list-style-type: none"> • Claims and premium analysis. The ability to analyze detailed claims and premium history by product, policy, claim type, and other specifics • Customer analysis. Analyze client needs and product usage patterns, develop marketing programs on client characteristics, conduct risk analysis, improving client service • Risk analysis. Identify high-risk market segments and opportunities in specific segments, relate market segments, reduce frequency of claims
Banking, finance and securities	<ul style="list-style-type: none"> • Customer profitability analysis. Determinate the overall profitability of individual customer, current and long term, provide the basis for high-profit sales and relationship banking, maximize sales to high-value customers, reduce costs to low-value customers, provide the means to maximize profitability of new products and services • Credit management. Establish patterns of credit problem progression by customers class and type, warn customers to avoid credit problems, to manage credit limits, evaluate of the bank's credit portfolio, reduce credit losses • Branch sales. Improve customer service and account selling, facilitate cross selling, improve customer support, strengthen customer loyalty
Telecommunications	<ul style="list-style-type: none"> • Customer profiling and segmentation. Determine high-profit product profiles and customer segments, provide detailed, integrated customer profiles, develop of individualized frequent-caller programs, determine future customer needs • Customer demand forecasting. Forecast future product needs or service activity, provide basis for churn analysis and control for improving customer retention
Manufacturing industry	<ul style="list-style-type: none"> • Sales. Provide analyses of customer-specific transaction data • Forecasting. Forecast demand, define inventory requirements • Ordering and replenishment. Order optimum quantities of items • Purchasing. Helping distribution centres manage increased volumes. • Distribution and logistics. Can use advance shipment information to schedule and consolidate inbound and outbound freight • Transportation management. Developing optimal load consolidation plans and routing schedules • Inventory planning. Identify the inventory level needed, ensure a given grade of service

Source: (Reinschmidt, & Francoise, 2000; cited by Olszak & Ziemba,2006)

IBM introduces the intention of Business Intelligence systems as sustainment of the process of transforming data into actionable information. They also describe some general BI applications such as market segmentation, customer profiling, campaign analysis, fraud detection, risk analysis and profitability analysis. Many corporations are implementing solutions that integrate business intelligence into business processes through automation. Some examples of these integrated solutions are Customer Relationship Management (CRM), Campaign Management Systems (CMS), Risk Management and Supply Chain Management (SCM) or Supplier Relationship Management (SRM).(IBM, 2000)

2.6- *BI for financial companies*

Nadeem in his research explain that there are some factors such as globalization, deregulation, fusions and achievements, competition from non-financial institutions, and technological innovation, have influenced the financial services industry and forced companies to re-think their business. Many large companies have been using Business Intelligence (BI) computer software for some years to help them gain competitive advantage. With the emergence of cheaper and more comprehensive products to the market place, BI is now in the reach of smaller and medium sized companies. Business Intelligence is also known as knowledge management, management information systems (MIS), Executive information systems (EIS) and On-line analytical Processing (OLAP). (Nadeem and jaffri, 2007)

"BI software can be used to query financial views such as (Rasmussen et al., 2002): Sales order entry, Sales by top customers with time comparisons; sales by customer and salesperson; sales by customer by location; etc. Accounts receivable, Aging periods by salesperson, aging periods by collection manger, and collections by customer and Bank reconciliation. Cash in the bank; cash on First National Bank; etc. General ledger. Sales and profit by channel; actual, budget, and variance by division; etc." (Chou et al, 2005)

2.7- BI models

Some of papers noted that BI is a process, and from different sources, it can be concluded that this view is right and applicable, here we will see different views about BI process.

Von Krogh introduces BI as the process of gathering information in the field of business; the process of transforming data into information and then into knowledge. BI is a precious core competence and should be managed like traditional factors of labor, capital and raw materials (Von Krogh et al., 1998; cited by Green, 2006).

Schermerhorn says that the typical business intelligence process consists of a series of activities that involve identifying, gathering, developing, analyzing, and disseminating information. One of the important steps in the process is to identify the customers, suppliers, competitors, stockholders, public-interest groups, labor unions, political parties, governments or other variables in the environment to be monitored (Schermerhorn, 2001; cited by Chau et al, 2006).

Azvine has been introducing These different views of BI and defined that BI is all about how to capture, access, understand, analyze and turn one of the most valuable assets of an enterprise — raw data — into actionable information in order to improve business performance.(Azvine et al., 2005)

In this figure, you can see the process of BI.

Figure 2-δ .Business Intelligence-turning data into information into action

Source: (B Azvine,2005)

Moreover, the three level of BI stack presented by B Azvine

Figure 2-ζ .The three layers of the BI stack

Source: (B Azvine et al,2005)

Michalewicz describe the common objective of business intelligence systems as follow;

(1) Admission data from a diversity of different sources; (2) convert these data into information, and then into knowledge; and (3) provide an accessible graphical interface to display this knowledge. In his view a business intelligence system is in charge of collecting and processing data, and presenting knowledge in a friendly way, which means enhancing the end user's ability to make good decisions. The following figure demonstrates the processes that support a traditional business intelligence system. (Michalewicz et al., 2007)

Figure 2-^v .Data transforming to knowledge

Source: (Michalewicz et al., 2007)

Nadeem explains Business intelligence as the process of gathering high-quality and meaningful information about the subject matter being researched that will help the individual(s) analyzing the information, draws conclusions or make assumptions.” (Jonathan, DMR 2000; cited by Nadeem and jaffri, 2007)

Rouibah knows Business intelligence (BI) as a strategic approach for analytically targeting, tracking, communicating and transforming applicable weak signs into actionable information on which strategic decision-making is based.(Rouibah and Ould-Ali, 2002)

There are several similar variants of BI processes but there is one process which mainly oriented toward weak signs management. This process is explained below.

The first phase of this process is 'targeting' which consists of springing the observation of the company's environment to assign tracking priorities. The second phase consists of organizing tracking and selecting the critical weak signs. The third phase consists of overthrowing the weak signs collected from outside to inside the organization. The fourth phase 'interpreting' consists of converting the collected information into practical intelligence. (Martinsons, 1994; Lesca and Caron, 1995; cited by K.Rouibah and S.Ould-ali,2002).

Figure 2-^ .Business Intelligence phases

Source: (Rouibah and Ould-ali, 2002)

Jourdan indicates BI as both a process and a product, he explains the process as collected techniques that organizations use to develop useful information, or intelligence, that can help organizations survive and prosper in the global economy. And in his view

the product is information that will allow organizations to predict the behavior of their "competitors, suppliers, customers, technologies, acquisitions, markets, products and services, and the general business environment" with a degree of certainty (Vedder, Vanecek, Guynes, & Cappel, 1999; cited by Jourdan et al., 2006).

The process of BI is based on transformation of data to information, then to decisions and finally to actions. (Turban et al, 2007)

Figure 2-4 .The business intelligence reference process

Source: (Baumgartner et al,2007;cited by turban et al,2007)

Rieger explains BI as a three steps process. The main process steps are:

"Data integration, data storage and data usage" and he indicates that the most important step in this process is data integration, which coats techniques to take out data from internal or external data sources. Conventionally, the data is derived for example

from database systems in a so-called ETL process (extract, transform, and load). (Rieger, 2005)

Giovinazzo define BI process as a loop which is composed of three fundamental steps: "acquire the data, analyze the data, and take action based on the data". (Giovinazzo, 2002)

Figure 2-10 .Business Intelligence loop

Source: (Giovinazzo, 2002)

2.8- BI measurement and Maturity Assessment model

2.8.1- Measurement of BI

The most important thing in using and applying Business Intelligence is measurement. The process should be measured in order to understand the improvement level. For managing the process of BI, the BI specialized is considered the main user of the measurement information. Information Builders, who is a supplier of BI products and services, suggests that three distinctiveness of intelligence should be measured: "deploying ability, scalability and usability of the intelligence." (Information Builders 2004; cited by Pirttimäki et al., 2006).

Pirttimäki indicated that William have presented a technique in 2004, which called “BI Readiness Assessment” this method have been used to verify the position of different subjects that are related to an organization’s capability to apply BI. These concepts comprise culture of constant improvement, information or analytics culture and technical readiness. (Pirttimäki et al., 2006)

Pirttimäki in his research indicate that the BI is measured for two purposes:

Table2-3 .two types of BI measurement

Purpose for Measurement	Main Users of Measurement Information	Expected Benefits
Determining the value of BI	Executives justifying BI investments BI professionals BI service providers Researchers	Ability to cost-justify BI services and demonstrate the actual effects of BI Increased credibility of BI as a managerial tool
Managing the BI process	BI professionals BI service providers	Improved rigor in BI research continuous improvement of BI products and services

Source: (Pirttimäki et al., 2006)

2.8.2- Performance of a BI Process

The literature presents several BI process models. According to Pirttimäki and Hannula (2003), the biggest differences among them are the number of phases, arrangement of series, sources of information, storage methods of information, and type of information collected. They stated a four-phase BI process model which includes:

- Recognition of information needs
- Information acquirement
- Information analysis
- Storage and information utilization

In the phase one, the organization must realize what kind of business information is necessary to determine different problems and to construct successful decisions. Just relevant information used in decision-making. The second phase is believed a compound

function because there are many different sources of information; internal and external information. In the phase three, information is analyzed and then enclosed into different information products and services. The objective of business intelligence process is making the possibility to business users to utilize the right information. Before the processed information can be utilized, information must be conversed to the significant decisions makers and distributed at the right time with appropriate tools. The main goal of the fourth phase is sharing the analyzed information. Finally, the consumption phase cannot be successful if one of the earlier phases in the BI cycle has failed. Therefore, response is critical to optimize each phase of the BI cycle. (Pirttimäki et al., 2006)

Figure 2-11 .Different Ways to Measure a Success Factor of a BI Process

Source: (Pirttimäki et al., 2006)

2.9 Maturity models:

Maturity models are models which measure and track progress in the organizations. Some common maturity models are: Organizational Project Management Maturity Model (OPM3), Project Management Maturity Model (PMMM), Capability Maturity Model Integration (CMMI)

Table2- 4.Common maturity models

	OPM 3 (PMI)	PMMM (Kerzner)	CMMI (SEI)
Level 1	Standardize	Common Language	Initial
Level 2	Measure	Common Processes	Managed
Level 3	Control	Singular Methodology	Defined
Level 4	Continuously Improve	Benchmarking	Quantitatively Managed
Level 5		Continuous Improvement	Optimizing

Source: (CMMI model, Kerzner, OPM3 model)

2.9.1 Kerzner maturity model

In Strategic Planning for Project Management Using a Project Management Maturity Model (John Wiley & Sons, Inc., 2001), Harold Kerzner stated five levels for reaching excellence in project management (PM).

- Level1, common knowledge of PM
- Level2, process are defined and are applicable and repeatable
- Level3, combining all corporate methodologies
- Level4, process improvement is required to maintain a competitive advantage
- Level5, continuous improvement evaluates the improvement to PM

Kerzner extended the PM maturity roadmap by revising project management efforts and lessons learned in hundreds of organizations.

Kerzner describes maturity in PM as the development of systems and processes that are repetitive in nature and provide a high probability that each project will be a success. After Level 3 is achieved, Levels 3, 4, and 5 form a continuous, repetitive cycle through which an organization achieves PM excellence. Management must recognize the need for, benefits of, and applications of PM and must clearly understand that since excellence in

PM will affect the organizational outcome, it is essential for survival. Organizations that transform to PM rarely give it up--because it works. (Kerzner, 2001)

2.9.2 OPM3

OPM3 or Organizational Project Management Maturity Model is a standard introduced by the Project Management Institute, USA .in Dec 2003. OPM3 will help organizations in reexamining their pursuit of strategic objectives via Best Practices in organizational project management. It documented substantial number of generally accepted and proven practices in project management and provides means to assess an organization's capability with respect to best practices. An assessment with this model can be used in making decisions with regard to planning and implementing improvements towards organizational maturity. (PMI, 2003)

The opm3 has four stages of improvement, standardize, measure, control and continuously improve (SMCI)

Figure 2-۱۲ .OPM3 cycle

Source: (PMI, 2003)

2.9.3 CMMI

CMMI history

At this time more than ever, companies would like to deliver products and services better, quicker and in better price. Also, in the high-technology world, almost all organizations are producing compound products and services. In the existing marketplace, there are maturity models, standards, methodologies, and guidelines which help an organization to progress the way it does business. But most of these methods just spotlight on a definite part of business, the Software Engineering Institute (SEI) introduced CMMI in order to have an integrated model to improve business processes. Organization's Processes allow us to support the way we do business. They allow us to address scalability and provide a way to integrate knowledge of how to do things better. Processes allow us to control our supply and to observe business. (CMMI product team, 2006)

Figure 2-۱۳ .The three critical dimensions

Source: (CMMI product team,2006)

Walter Shewhart worked in process progressing with his attitudes of statistical quality control in 1030s. after that, W. Edwards Deming improved these attitudes, and then Crosby , Juran , Humphrey, Radice and some others broadened these principles even more advanced and began applying them to software in their work at IBM and the SEI (1989). Humphrey stated in his book and explanation of the basic principles and concepts on which many of the capability maturity models (CMMs) are based. The SEI has taken the process management premise, “the quality of a system or product is highly influenced by the quality of the process used to develop and maintain it,” and defined CMMs that embody this premise. CMMs spotlight on improving processes in an organization. The CMM Integration SM project has been formed to class out the problem of using multiple CMMs. The CMMI Product Team’s initial mission was to combine three source models:

1. The *Capability Maturity Model for Software* (SW-CMM) v2.0 draft C (1997)
2. The *Systems Engineering Capability Model* (SECM)(1998)
3. The *Integrated Product Development Capability Maturity Model*(IPD-CMM) (1997)

The combination of these models into a single improvement framework was intended for use by organizations in their pursuit of enterprise-wide process improvement. (CMMI product team, 2006)

Figure 2-۱۴ .The history of CMM

Source: (CMMI product team, 2006)

Capability Maturity Model Integration (CMMI) is an integrated model of many Capability Maturity Models that consist of best process practices (Chrissis et al., 2003).

Yoo indicated that CMMI has 25 process areas (PA). And he defines a process area as a set of practices in specific areas which, when implemented in a group, convince a set of goals, resulting in a significant improvement in that. (Yoo et al., 2006)

A simplified representation of the world is defined as a model. The essential elements of effective processes for various applications are contained in Capability maturity models (CMMs). Development of capability maturity models have commenced from 1991 for a myriad of disciplines. In collaboration with the software community, the Software Engineering Institute of the Carnegie Mellon University developed The

SWCMM and it has become a de facto standard for assessing and improving software processes since its publication in 1991.

Afterwards, integrated product and process development Models, software acquisition, workforce management and development were introduced. Despite the usefulness of these models to various organizations, utilization of multiple models has resulted in some problems.

The CMM integration project was formed to sort out the problem of using multiple CMMs by combining their models into a single improvement framework for use by organizations pursuing enterprise-wide process improvement (Carnegie Mellon University).

The SW-CMM and the systems engineering capability model are integrated into the CMMISM-SE/SW with the concepts from integrated product and process development (IPPD) in order to provide an improvement framework for evaluation of capability maturity in both software and systems engineering aspects of an organization. CMMISM models guide the usage while processes are developed just like other CMMs. CMMISM models are not only processes or process description; many factors such as application domain(s) and organization structure and size influence the actual processes used in an organization. The CMMISM goal is ultimately, to guide through the improvement of the organization's processes and the development, acquisition, and maintenance of products and services management ability. CMMISM structures the proven approaches and helps the appraisal of the organization organizational maturity or process area capability, and also the priorities establishment of improvement, and implementation of these improvements. The capability maturity model integrated (CMMISM) introduces the ways through which your organization's ability to manage the development, acquisition and maintenance of products and services can be improved. Also it has the potential to significantly improve the organizations' efficiency and profitability. CMMISM enables the assessment of organizational maturity and process area capability. The priorities for improvement are identified, the guidance on the implementation of these improvements is provided. (Dayan and Evans, 2006)

CMMI models are developed for four disciplines:

1. Systems engineering.
2. Software Engineering.
3. Integrated product and process development.

4. Supplier sourcing.

As an integrated model, the CMMISM has its sources in all these disciplines. However this model does not include them all. (Dayan and Evans, 2006) .

CMMI and process

There are several types of processes mentioned in the SSE-CMM, including but not limited to “defined” and “performed” processes. Security engineers in the organizations are the ones who use the defined process. The description of this process may be available in a document or a process asset library for example. In other words, the organization's security engineers are supposed to do the defined processes. What the security engineers actually do is the performed process.

There is a value in the building of capability measurement in superseding levels itself. Without mastering the confidence of the basic capabilities, advancement to a higher capability is like constructing a pyramid stand on its head and hoping it remains stable, and to reflect the situation across the organization and not merely at chosen locations. By first achieving stability at the project level and continuing to the most advanced-level, organization-wide continuous process improvement using both quantitative and qualitative data to make decisions, the organization can achieve progressive improvements in its maturity. A set of related practices in an area when performed collectively forms a process area which satisfy a set of process goals considered important for making significant improvement in that area. Statements about process areas which describe what a process area should achieve to make significant process improvements are process goals are.

The classification of the process areas are as follows:

1. Engineering.
2. Project management.
3. Process management.
4. Support.

Process areas correspondent to the maturity level in its staged representation are addressed in CMMISM. (Dayan and Evans, 2006)

Discrete levels of process improvement are described in CMMISM models. (CMMI Product Team, 2002)

Discrete levels of process improvement are described in CMMISM models. A recommended order for approaching process improvement in stages is provided in the staged representation by the maturity levels. Maturity levels organize the process areas. Common features organize generic practices. The main focus of this is on good practices the organization is able to use in order to improve processes in the process areas which are within the maturity level it chooses to achieve. Before commencement of CMMISM model utilization for improving processes, the processes should be mapped to CMMISM process areas. By assisting the track of organization's level of conformance to the CMMISM model, control over process improvement in the organization is enabled by this mapping. Hereby, the various process areas relevant to the different CMMISM levels are examined and the appropriate KM procedures are looked for. (Dayan and Evans, 2006)

Table2-Δ .SEI software process maturity levels characterized

MATURITY LEVEL	LEVEL DESCRIPTION
1. Initial	The software process is characterized as ad hoc, and occasionally even chaotic. Few processes are defined, and success depends on individual effort.
2. Repeatable	Basic project management processes are established to track cost, schedule, and functionality. The necessary process discipline is in place to repeat earlier successes on projects with similar applications.
3. Defined	The defined process for both management and engineering activities is documented, standardized, and integrated into a standard software process for the organization. All projects use an approved, tailored version for the organization's standard software process for developing and maintaining software.
4. Managed	Detailed measures of the software process and product quality are collected. Both the software process and products are quantitatively understood and controlled.
5. Optimized	Continuous process improvement is enabled by quantitative feedback from the process and from piloting innovative ideas and technologies.

Five maturity levels of CMMI

CMMISM in its staged arrangement is being measured at five different levels. A maturity level is a precise plateau of process growth. Each maturity level alleviates an

important part of the organization's processes. Maturity levels consist of a predefined set of process areas. The maturity levels are measured by the attainments of the objectives that apply to each predefined set of process areas. The model consists of five maturity levels, each layer being the basis for ongoing process improvement:

1. Initial; in this level process is unpredictable, poorly controlled, and reactive.
2. Managed; in this level process is described for projects and is often reactive.
3. Defined; in this level process characterized for the organization and is proactive.
4. Quantitatively managed; in this level process measured and controlled.
5. Optimized; in this level focus is on process improvement. (Dayan and Evans, 2006)

Figure 2-١٥ .The five levels of software process maturity

CMMI for improving processes

CMMI is used as a channel for progress the industry processes. Before beginning using a CMMI model for improving processes, the processes must be plotted to CMMI process areas. This plotting facilitates the association to monitor process improvement by helping that follow its organization's level of conformance to the CMMI model they are

using. Capability levels enable them to trail, calculate, and reveal their organization's progress as they improve processes related to a process area. Capability levels build on each other, providing a recommended order for approaching process improvement.

Figure 2-۱۶ .CMMI model components

Source: (Carnegie Mellon,2001)

2.10 Conclusion

It's concluded that BI is a process and for testing the improvements of organizations in this process, CMMI has been introduced. The process, which is considered in this research, is the Giovinazzo model. This process has three levels including: acquiring the data, analyzing the data, and taking action based on the data. this process has been take as core model of research because is closer to process of Iranian banking Industry.

Chapter 3

Research methodology

Introduction

This chapter is going to describe the research methods used in this study. It will also describe the research process and both overall and detailed way, the research purpose, research approach, research strategy, population and sample selection and data collection and research variables will be discussed.

3.1- Research Type in base of purpose

We have diverse categorizations of researches in base of purpose; in this study the most common definitions has been indicated. Yin (1994) and Zikmund (2000) say that there are three main categories in base of purpose. These are exploratory, descriptive and explanatory.

- **Exploratory**, The purpose of exploratory research is to collect preliminary information that will help identify problems and advocate hypotheses. (Kotler et al. 2006). Exploratory research provides insights into and comprehension of an issue or situation. Exploratory studies are valuable tools for understanding what is happening to search for new insights; to ask questions and to evaluate happenings (Saunders et al. 2000). Yin explained that an exploratory study is a chiefly useful approach if one wishes to clarify the understanding of a problem. The benefit of exploratory research can be that it has immense elasticity and is adjustable to change. The flexibility inbuilt in exploratory research does not mean deficiency of direction.

- **Descriptive** research has been described surrounded by problem areas where there already exists bounty of literature and the objective is to study occurred events in current time. The goal of descriptive research is to explain attributes of a population or phenomenon. It look for to the answers to who, what, when, where and how questions (Zikmund, 2000). Yin stated that the aim of descriptive research is to expose an accurate profile of persons, events or situations. Typically it is taken as a conservatory of or a predecessor to a piece of exploratory research (Robson, 1993). Zikmund (2000) noted that accuracy is of massive importance in descriptive research. Though confess errors cannot be eliminated completely, a good research struggles for descriptive exactitude. It has been taken based on some previous knowledge and understanding of the nature of the research problem. Malthotra quarrels that it is often seen that more than one research types (exploratory, descriptive and explanatory) are employed in a single study to achieve different objectives. Hypothesis developed through exploratory study are statistically tested using descriptive or explanatory research. The descriptive research is

conducted with the objective to describe an accurate description of events, situations or persons (Saunders et al., 2003).

- **Explanatory** research plans at starting contributory relationship variables. Here the highlighting is on sentencing a condition or a problem in order to finding out the relationships between variables (Saunders et al. 2000). Typically, exploratory and descriptive research starts this kind of research and according to Zikmund (2000) the research must be instructed about the research subject.

The research purpose in this study has been assessed as **descriptive**. The study is descriptive because intentionally relied on variables and models drained from the theory and stated. In other Words, this research is intended to describe the BI maturity level in Iranian banking organizations. By using this study, we can understand the characteristics of a specific population which is Iranian banking organizations.

3.2- Research approach

Research Approach submits to two different attributes of a research: Qualitative versus Quantitative and Deductive versus Inductive.

3.2.1- Quantitative versus qualitative

As Cooper stated there are two different approaches to consider, When conducting research: Quantitative and Qualitative (Cooper and Schindler, 2003).

- **Quantitative** research methods generally involve large randomized samples, more statistical function, and few applications of cases demonstrating findings. The key objective of quantitative research is to determine the relationship between one thing (an independent variable) and another (a dependent variable) in a population. In addition, quantitative methods are often applied within natural science, and the aim is usually explanatory to explain causal relationships, to facilitate generalization, and also to forecast the future (Cooper and Schindler, 2003). The quantitative research objective is to formulate generalizations based on the research result. A quantitative advances the research problem from an extensive outlook and is relatively structured and formulized, meaning that a limited amount of information is collected from various research units

systematic and structured observations. The quantitative research results are supposed to be measurable and acceptable in numbers and statistics (Holmes and Solvang, 1991). In other words, quantitative methods transform the information to numbers and amounts that later will be analyzed statistically. Besides, in the qualitative method the researcher's insight and explanation will be considered. The qualitative research aims at achieving a better understanding of the fact that is being studied and this is conducted by gaining a large amount of information from few research parts. Moreover, qualitative studies be predisposed to be more flexible, while the quantitative ones are more structured (Holmes and Solvang, 1997)

- **Qualitative** research methods provide absolute portrait of the situation increasing the understanding of social processes and interrelations is their objectives. It is defined as a research to discover and understand the attitudes and endeavor for comprehensively understanding of different kind of findings in library research (Cooper and Schindler, 2003). Ruyter and Scholl (1998) stated that Qualitative research tenders an insight into questions that address the way people think about a certain subject but it doesn't answer questions like how many people share a definite belief. Malhotra (1996) believes that qualitative research is an unstructured research methodology based on small sample that provides insights and understanding of the problem settings. According to Ruyter & Scholl (1998) qualitative research does not do the measurement, it provides insight. In qualitative research the concern is to cover the subject of study expansively. Further, qualitative research presents an in-depth insight, it is flexible, small-scale and the results obtained are tangible. Qualitative research is good in the areas of consumer decision making, consumer satisfaction and communication.

According to Yin (1994) choosing the best approach to apply for a study depends on the purpose of the study and the conveying research questions. Some researchers distinguish between qualitative and quantitative research, but there is a mutual basis for the two (Yin, 1994). Based on the purpose of this study and related research questions, as well as the above discussion, the procedure which has been chosen is included **both methods**. It is **quantitative** because to answering the major research question, researcher selected five maturity levels and wanted to measure them by the means of structured

questionnaire and through a survey. It is also qualitative since this sector of market in Iran is very specialized and beside library studies and reviewing performed researches in this field, interviewing with related experts and managers is necessary. Therefore, researcher conducted also a **qualitative** research in order to find out tailored answers for minor research questions.

3.2.2- Deductive versus Inductive

Saunders et al. (2000) believes that, the approach to a research can either be deductive or inductive. They explain that deductive approach deals with the development of a theory and hypotheses by designing a research strategy to test it. However, the inductive approach will use data collected to develop theory based on the analysis of that data. As far as this study is concerned, the deductive approach was chosen since the research is based on existing literature review. Theories were compared with the empirical findings before finally conclusions are made. The inductive way to draw conclusions is founded on empirical data. The researcher established theories and models that are based on different phenomena in reality. If the researcher on the other hand has a deductive approach then he/she uses existing theories, and investigates these empirically, with different methods (Eriksson et al., 1997). Existing theory is the base for deciding what information that should be selected, how it should be understood and, finally, how to relate the results to the theory (Patel and Davidson, 1994)

This study is deductive due to the way researcher developed the purpose and research questions. Researcher has started from already existing theories, which can be latterly compared with reality. Finally, researcher aims to draw logical conclusions from findings.

3.3- Research strategy

According to Yin (1994), there are five primary research strategies in social sciences: experiments, surveys, archival analysis, histories and case studies. Each strategy has certain advantages and disadvantages, which are determined by three conditions as illustrated below (Yin, 1994):

Table 3-1 . research strategies

Strategy	Form of research question	Requires control over behavioral events?	Focuses on contemporary events?
Experiment	How, why	Yes	Yes
Survey	Who, what, where, how many, how much	No	Yes
Archival analysis	Who, what, where, how many, how much	No	Yes/No
History	How, why	No	No
Case study	How, why	No	Yes

Source: (Yin, 1994)

Most important condition for selecting research strategy is to identify the type of research question being asked. "Who", "What", "Where", "How" and "Why" are the categorization scheme for the types of research questions. Two possibilities need to investigate by asking the "What" question. First, some types of what questions are justifiable for conducting an exploratory study and the goal is to develop pertinent hypotheses and propositions for further inquiry. Any of the five research strategies can be used in that situation- exploratory survey, exploratory experiment, or an exploratory case study. The second type of what question is actually form a "how many" or "how much" line of inquiry and the outcomes from a particular situation. The survey or archival analysis is more favorable than other strategies. If the researcher needs to know the "how" question, the better strategy will be doing history or a case study (Yin, 1994).

Since the major research question in this study is based on "How" question and the researcher is looking for assessing the maturity level of BI in Iranian banking organizations, and investigator has no control over the actual behavioral events, **survey** is found to be the most appropriate approach in order to gain a better understanding of the research area. In addition, survey is more appropriate method in order to conduct a better research in quantitative study.

3.4- Research design

“Research design is the plan and structure of investigation so conceived as to obtain answers to reach questions. The plan is the overall scheme or program of the research. It includes an outline of what the investigator will do from writing hypotheses

and their operational implications to the final analysis of data. A research design expresses both the structure of the research problem and the plan of investigation used to obtain empirical evidence on relations of the problem” (Cooper & Schindler, 2003). In fact, the choice of research design must be appropriate to the subject under investigation. “A good research design will ensure that the information collected will be consistent with the objectives of the study and that the procedures regarding data collection is accurate and efficient.” (Cooper & Schindler, 2003)

3.5- Research variables

Distinction of variables is necessary in a research to reach to the response to a research question or hypothetical tests. Researchers are most interested in relationship among variables (Cooper and Schindler, 2003). Three types of variables have been taken into account in the present research:

- **Independent Variable:** is a specialty from physical and social environment that is accepted after the selection, interference or modification by a quantitative researcher so that its impact may be observed on other variables (dependent variable). (Cooper and Schindler, 2003)
- **Dependent variable:** is a variable in which changes occur under the impact of independent variable (Cooper and Schindler, 2003)
- **Moderating variable:** a moderating variable is a second independent variable that is included because it is believed to have a significant contributory or contingent effect on the originally stated dependent-independent variables relationship (Cooper and Schindler, 2003).

In this study, the capability of **acquiring the data, analyzing the data, and taking action based on the data** are considered as independent variables and **BI Maturity level** is considered as dependant variables.

Table 3-۲ .research variables

Factors	constructs
Acquire the data	1. data gathering 2. Extraction 3. transformation 4. cleansing 5. data storage 6. data warehouse
Analyze the data	7. reporting & dashboard 8. Online Analytical Processing 9. OLTP 10. Data Mining
Take action based on the data	11. Business strategist

3.6- Methods and resources of data collection

There are two forms of data which can be used for a particular study (Malhotra 1996, p.30). The researcher can either generate new data for the purpose in hand (primary) or use available data already generated for some other purpose (secondary data). As there is no similar study in this segment of industry, therefore using secondary data is impossible . Collecting primary data by different means of data collection which are described below can satisfy the requirements of this study.

According to (Saunders et al., 2003, p.329) the data can also be categorized as quantitative and qualitative. In this study we will concentrate on *qualitative and quantitative* data. Saunders et al. (2003, p.315) argued that the selection of data collection method should be consistent with the research purpose and research questions. Since this study uses questionnaire as a quantitative method and focus group and interview as a qualitative method for collecting the required data.

- **Questionnaire**

Questionnaire is a collection of written queries, which is arranged putting all the essential variables for the research and can be completed by respondents in presence, in absentia, directly or indirectly (Cooper and Schindler, 2003).

- **Focus Group**

Focus group method of data collection is being used quite frequently in qualitative studies.

A focus group is a form of qualitative research in which a group of people are asked about their attitude towards a product, service, concept, advertisement, idea, or packaging. Questions are asked in an interactive group setting where participants are free to talk with other group members. Moreover Focus groups are a form of qualitative research; a loosely structured means of obtaining opinions related to a specific topic. Groups usually consist of eight to ten people recruited and brought together based on pre-specified qualifications. Focus groups are typically conducted in-person at a research facility, but more recently Tele-focus groups (via telephone conferencing) and Internet focus groups have become more popular. Generally two or more focus groups are conducted as part of a given study in order to provide comparisons between groups for greater detail in the research analysis. Focus groups also can be used to generate ideas in a group brainstorming session. They are frequently utilized in developing questionnaires. By getting feedback in advance from people representative of those you hope to target with a survey, you can better word your questions and design clearer explanations of your concepts. A professional moderator runs a focus group. The moderator's job is directing the conversation and ensuring that all respondents voice their opinion. This technique is used for verifying the applicability and checking the face validity and content validity of the questionnaire of this research.

- **In-depth Interview**

According to Gubrium & Holstein (2002, p.104) the need for 'deep' information induce the researchers to go for in-depth interview. The information gathered through this

is much deeper than obtained through focus groups, informal interviews or surveys. here is some important points that are considered in conducting the interviews:

- **Face-to-Face.** An interview can be conducted by meeting the person face-to-face or on telephone (Saunders et al., 2003, p.247). According to Gubrium & Holstein (2002, p.541) the telephonic interviews are exhaustive for interviewer, but good in situations where access to strategic participants is not possible. A face-to-face interview is suggested in situations where research issues require complex questions and answers. At the same time, research has showed that telephonic interviews have faster pace and lack in thoughtful answers.

- **Interview Guide.** According to Saunders et al. (2003, p.261) if the interviewees are allowed to talk freely through out an interview then it is unlikely to lead to a clearly focused discussion on issues relevant to research topic.

- **Note-Taking, Voice Recording.** Gubrium & Holstein (2002, p.111) argued that since an individual's memory does not remember what he sees or listen in the same way rather stores it in some sort of memory-chunks. So it is important that in-depth interviews are always tape-recorded.. The tape-recorded responses are always more helpful in data presentation stage of a study. The interviewees should be conducted at silent, comfortable room during convenient timings as Malhotra (1996, p.167).

3.7- Statistical population

The basic idea of sampling is that by selecting some of the elements in a population, researcher may draw conclusions about the entire population. There are several compelling reasons for sampling, including: lower cost, greater accuracy of result, greater speed of data collection and availability of population selection (Cooper and Schindler, 2003).

Statistical population of this research is all financial and Credit institutes active in Iran whose number was 17 on 10/07/2008 based on statistics of the Iranian Central Bank.

Table 3- 3.population of research

Row	Name	Type	Experts No.
1	Bank Melli Iran	Public	12
2	Bank Sepah	“	10
3	Bank Tejarat	“	10
4	Bank Mellat	“	11
5	Bank Saderat	“	7
6	Bank Toseie saderat	“	7
7	Bank Keshavarzi	“	12
8	Bank Sanaat va Maadan	“	7
9	Bank Refah	“	7
10	Bank Maskan	“	3
11	Post Bank	“	5
12	Bank Eghtesad novin	Private	12
13	Bank Parsian	“	15
14	Bank Karafarin	“	12
15	Bank Sarmaie	“	14
16	Bank Saman	“	18
17	Bank Pasargad	“	14

3.8- The sampling Method

Selection of the sampling method to use in a study depends on a number of related theoretical and practical issues. These include considering the nature of the study, the objectives of the study and the time and budget available. Traditional sampling method can be divided into two categories: probability and non- probability sampling (Samouel et. al., 2003).

- **Probability** sampling is most commonly associated with survey-based research where researcher needs to make inferences from the sample about a population to answer the research questions or to meet research objectives (Saunders et. al., 2003). In probability sampling, sampling elements are selected randomly and the probability of being selected is determined ahead of time by the researcher. If done properly, probability sampling ensures that the sample is representative (Hair et. al., 2003).

- **Non-probability** sampling provides a range of alternative techniques based on researcher subjective judgment (Saunders et. al., 2003). In non-probability sampling the selection of elements for the sample is not necessarily made with the aim of being statistically representative of the population. Rather the researcher uses the subjective methods such as personal experience, convenience, expert judgment and so on to select the elements in the sample. As a result the probability of any element of the population being chosen is not known (Samouel et. al., 2003)

Table 3-۴ . sampling method

Equation	Sample No.	T	N	d	Q	P	Scenarios
$n_i = \frac{NT^r PQ}{T^r PQ + Nd^r}$	۶۲	۱/۹۶	۱۷۶	۰/۱	۰/۵۰	۰/۵۰	۱
	۷۰	۱/۹۶	۱۷۶	۰/۰.۹	۰/۵۰	۰/۵۰	۲
	۸۰	۱/۹۶	۱۷۶	۰/۰.۸	۰/۵۰	۰/۵۰	۳
	۹۲	۱/۹۶	۱۷۶	۰/۰.۷	۰/۵۰	۰/۵۰	۴
	۱۰۶	۱/۹۶	۱۷۶	۰/۰.۶	۰/۵۰	۰/۵۰	۵
	۱۲۱	۱/۹۶	۱۷۶	۰/۰.۵	۰/۵۰	۰/۵۰	۶
n= sample size, N=Volume of the statistical population, T= the percent confidence interval, Q = distance of assurance which is equal to 0.05 and d= Error degree							

3.9- Research process

The process, which is considered for this research, is formulated as below. At the first the conceptual design is illustrated and after that there is a detailed design which is shown by flow chart for each phase.

3.9.1- Overall Process of the research

Here is only the Research project lifecycle. In conceptual design we defined the project phases. We have considered 5 phases for this project ,as you can see below. The most important deliverables of each phase is shown in the box below each phase.

Figure 3-١ .overall process of the research

3.9.2- Detailed Process of the research

In this section a more detailed description is provided for each phase. For more convenient, a flow diagram is provided for each phase.

- **Phase 0:** this phase is considered as a preliminary phase for providing the necessary preparation of research project. Preparing a Project plan, defining the project scope, goals, schedule, Approach, Strategy and Methodology is considered to be done in this phase.

Figure 3-۲ .phase 0 flow chart

- **Phase 1:** reviewing the prior research and management literature is considered for this phase. Valid models which are presented before related to BI and Maturity level should be find and reviewed in this phase.

Figure 3-۳ .phase 1 flow chart

- **Phase 2:** preparing a valid and reliable assessment tool is intended in this phase. This tools must be applicable to the specified segment of industry.

Figure 3-۴ .phase 2 flow chart

- **Phase 3:** Disseminating the questionnaires and collecting them is intended in this phase. Tracking the process, solving the problems and describing the ambiguous questions and trying to collect more questionnaires is the aim of this phase.

Figure 3-Δ .phase 3 flow chart

▪ **Phase 4:** analyzing the returned questionnaires is intended in this phase. Finding out the maturity level of each institute in different process of BI and also finding out an overall maturity level of BI in the specified segment is important In this phase. Also recommending an improvement plan is intended.

Figure 3-9 .phase 4 flow chart

Chapter 4

Data analysis

Introduction

This chapter will present data that has been collected through quantitative survey. First of all the descriptive data will be presented, in addition the process of designing and developing the questionnaire will be described and then the validity and the reliability of measurement tool will be measured. At the end the verification of the model will be discussed and the ANOVA test will be presented.

4.1- Descriptive statistics

In descriptive statistics, we consider two different categories, the first category is the characteristics of banks, which are categorized by possession, age of bank and the number of branches of each bank, these characteristics of banks themselves may influence on our research results. Moreover, the second category is the responder's characters that are; sex, age, education and their position in the bank.

4.1.1- Banks characteristics

There are characteristics that differentiate each bank from the others, some of these characteristics shown in the following table.

Table 4-1 . Banks characteristics

Name	possession	Age	Branches
Bank Melli Iran	<i>public</i>	80	3216
Bank Sepah	<i>public</i>	83	1700
Bank Tejarat	<i>public</i>	29	2009
Bank Mellat	<i>public</i>	29	1872
Bank Saderat	<i>public</i>	56	3300
Export Development Bank of Iran	<i>public</i>	17	31
Bank Keshavarzi	<i>public</i>		1957
Bank Sanaat va Maadan	<i>public</i>	52	45
Bank Refah	<i>public</i>	48	1073
Bank Maskan	<i>public</i>	29	980
Post Bank	<i>public</i>		310
Bank Eghtesad novin	<i>private</i>	7	224
Bank Parsian	<i>private</i>	8	200
Bank Karafarin	<i>private</i>	7	66
Bank Sarmaie	<i>private</i>	3	73
Bank Saman	<i>private</i>	6	93
Bank Pasargad	<i>private</i>	3	193

Bank possession

The Iranian banks have different characteristics based on their possession; they divided in two groups, public and private.

Table 4- 2. Bank possession-descriptive statistics

Descriptive								
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
public	11	1.1	.04	.01	1.0	1.1	1.07	1.2
private	6	2.1	.04	.01	2.1	2.2	2.1	2.2
Total	17	1.5	.5	.1	1.2	1.7	1.07	2.2

Bank size

We considered the bank size according to number of branches, the banks with smaller than 100 branches considered small, between 100 and 1000 considered medium sized and with more than 1000 branches considered large.

Table 4- 3. Bank size-descriptive statistics

Descriptive								
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
Small	5	1.7	.5	.2	1.03	2.4	1.1	2.2
Medium	5	1.7	.5	.2	1.03	2.5	1.08	2.2
Large	7	1.1	.04	.01	1.09	1.1	1.09	1.2
Total	17	1.5	.5	.1	1.2	1.7	1.08	2.2

Bank age

We divided banks in two groups based on their age; the banks with more than 10 years old are old and less than 10 years are young or new

Table 4- 4.Bank age-descriptive statistics

Descriptive								
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
old	11	1.1	.03	.01	1.1	1.1	1.08	1.2
new	6	2.1	.07	.03	2.1	2.2	2.09	2.2
Total	17	1.5	.5	.1	1.2	1.7	1.08	2.2

4.1.2- Responder's characteristics

Responder's sex

The characteristics of the sample will be shown in this part, as it is obvious in the diagram, more than 60% of participants were male and 35% were female.

Figure 4-1 . Responder's sex -descriptive statistics

Figure 4- 2.Responder's sex -descriptive statistics

Descriptive								
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
1	56	1.6	.04	.00	1.5	1.6	1.5	1.6
2	43	1.6	.04	.00	1.5	1.6	1.5	1.6
Total	99	1.6	.04	.00	1.5	1.6	1.5	1.6

Responder's age

The next figure shows the distribution of sample based on age, as it is illustrated about 50% were between 20 to 30 years old.

Figure 4-۳ .Responder's age -descriptive statistics

Table 4- 5. Responder's age -descriptive statistics

Descriptive								
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
A	25	1.8	.2	.05	1.6	1.9	1.5	2.2
B	36	1.8	.2	.04	1.7	1.9	1.5	2.2
C	25	1.8	.2	.05	1.6	1.9	1.5	2.2
D	13	1.8	.2	.08	1.6	2.0	1.5	2.2
Total	99	1.8	.2	.02	1.7	1.8	1.5	2.2

Responder's education

The next figure exposes the sample division based on education.

Figure 4-۴ .Responder's education -descriptive statistics

Figure 4- 5.Responder's education -descriptive statistics

Descriptive								
	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
A	56	1.7	.2	.03	1.7	1.8	1.5	2.2
B	32	1.8	.3	.05	1.7	1.9	1.5	2.2
C	11	1.8	.3	.09	1.6	2.08	1.5	2.2
Total	99	1.8	.2	.02	1.7	1.8	1.5	2.2

Responder's position

In addition, the last figure illustrates sample distribution based on responder's position in the bank.

Figure 4-٦ .Responder's position -descriptive statistics

Figure 4- 7. Responder's education -descriptive statistics

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
exman	25	1.4	.6	.1	1.1	1.7	.00	2.9
middleman	32	1.6	.7	.1	1.3	1.9	.4	3.5
expert	42	1.5	.7	.1	1.2	1.7	.1	3.1
Total	99	1.5	.7	.07	1.3	1.6	.00	3.5

4.1.3- Operational measures of the research variables

This research considers 11 constructs that introduce the individual characteristics of each Business Intelligence level. As it is shown in the following table.

As mentioned, before all items used a five-point Likert-type scale ranging from zero to four derived from CMMI model.

Table 4-7 . Operational measures of the research variables

Variables influence on BI maturity	Mean	Std. Dev.	Skewness
Data gathering	3.1	1.01	-0.3205
Data extraction	0.8	0.3	-0.2
Data transformation	1.8	0.6	-0.1
Data cleansing	1.7	0.7	-0.1
Data storage	1.5	0.7	-0.0
Data warehouse	0.2	0.3	-0.1
Reporting and dashboard	2.3	0.9	-0.1
Online analytical processing	1.3	0.5	-0.2
OLTP	1.9	0.9	-0.2
Data mining	1.2	0.7	-0.3
Business strategist	2.1	0.9	-0.0

4.2- *Designing and developing the questionnaire*

Regarding the nature of research questions which are mainly descriptive, survey and quantitative observations are the core technique in descriptive research design, as measuring the maturity level of BI is the goal of this research, it is preferred to conduct a survey. Survey techniques are based upon the use of structured questionnaires given to a sample of a population (malhotra, 2005).

The questionnaire is designed considering different researches which have been done in the case of BI such as SPEKs project. And then the experts revised the questionnaire and did some correction in the case of terminology. Also the reliability, validity and applicability of questionnaire measured, which is explained in chapter three.

4.3- *Validity and Reliability of Measurement tool*

Measurement tools are means, which researchers apply to collect and record the needed information during the course of research. Some of these tools are questionnaire, observation and interview. Questionnaire is a collection of written queries, which is arranged putting all the essential variables for the research and can be completed by respondents in presence, in absentia, directly or indirectly. Measurement scales are the units that are applied to test the qualities in the information collection tools. These are nominal, ordinal interval and ratio scales (Cooper and Schindler, 2003). This research has used the questionnaire to collect the information related to BI maturity level in Banking Organizations in Iran.

4.3.1- *Reliability of measurement tool*

Reliability means that if the test is repeated under similar condition, to what extent the findings are similar and reliable a measure is reliable to the degree that is supply consistent results (Cooper and Schindler,2003). Different methods are available to measure the reliability such as retest method, split-half method, parallel (equivalence) method, Richardson method and, Cronbach alpha coefficient method. The popular and

commonly used method to assess internal consistency is Cronbach alpha. Hair et al. (2007) have provided rules of thumb for interpreting alpha values. They mentioned an alpha of 0.70 or higher as an appropriate range to measure the reliability. The reliability of the research is whether will the measures yield the same results on other occasions or not, whether will the similar observation be reached by other observers or not, is there transparency in how sense was made from the raw data or not? (Saunders et al., 2003, p.101) To assess the reliability of the questionnaire during this research, **Cronbach alpha** is used.

The Cronbach Alpha is tested two times. First we calculated this index based on questionnaires filled out by 30 interviewees. Based on the derived model, there is 3 factors that we Calculated Cronbach alpha for each. As it has shown in following table, the values were greater than 0.7 which represents a good internal consistency and could assure the Reliability of the questionnaire. After disseminating the questionnaires and gathering them back we calculated the cronbach alpha again.

Table 4- 7. cronbach alpha

Construct	First Test	Second Test
data gathering	0.7	0.7
Extraction	0.8	0.8
Transformation	0.8	0.7
Cleansing	0.8	0.8
data storage	0.7	0.7
data warehouse	0.9	0.9
reporting & dashboard	0.8	0.8
Online Analytical Processing	0.8	0.7
OLTP	0.7	0.7
Data Mining	0.9	0.8
Business strategist	0.7	0.7

4.3.2- Validity of measurement tool

According to Saunders et al. (2003, p.101) the validity of research is concerned with whether the findings are really about that they appear to be about Stenbacka (2001) argued that the understanding of the phenomenon is valid if the problem area and the interaction between researcher and informant gives the latter the opportunity to speak freely according to his/her own knowledge structure Concept of validity or internal validity response to how precisely the questions measure corresponding components. To determine the validity of questionnaires, various methods are available; in current research we will use Face validity and Content validity methods.

Face validity is a property of a test intended to measure something. The test is said to have face validity if it "looks like" it is going to measure what it is supposed to measure. (Banks, J. (2005). *Discrete-Event System Simulation*). For instance, if you prepare a test to measure whether students can perform multiplication and the people you show it to all agree that it looks like a good test of multiplication ability; you have shown the face validity of your test.

Some people use the term face validity only to refer to the validity of observers who are not expert in testing methodologies. For instance, if you have a test that is designed to measure whether children are good spellers, and you ask their parents whether the test is a good test, you are studying the face validity of the test. If you ask an expert in testing spelling, some people would argue that you are not testing face validity (Anastasi 1988, pg. 144).

For verifying the face validity, we asked 12 clerks of banks to check the questions and find out whether these questions are related to the topic or not. These clerks were not expert in IT but they were involved in banking industry. We changed the wording of 8 questions and we omit one question and combined 2 questions. After these modifications more than 10 people out of 12 were satisfied with questions.

Content validity method is used to study the formation ingredients of a measurement tool. This method usually is determined by experts in the proposed study subject. Content validity is one of the most important attributes of any questionnaire. There for we put a large amount of efforts for ensuring about this subject. At first the questionnaires were considered by research advisor and supervisor and some changes were accrued. After that 5 BI and IT experts from Eghtesad Novin Bank and Parsian Bank were asked to check the questions. They were asked to check whether the questions are asking the subject and if they are precise enough or not. They confirmed that the questions are accurate and precise. At 3rd stage we compared the questions with valid questionnaires and most frequently used ones and changed wording of 2 questions and added one more questions.

4.4- Sample and response rate

According to the experts in each bank we planned a schedule for disseminating the questionnaires. The plan is illustrated in following figure. Despite all the efforts, some experts didn't answer the questions. At first we disseminate 110 questionnaires and 91 were answered. 6 questionnaires were not answered properly and we omitted them. As we need at least 92 well answered questions, we send 20 more questionnaires again which 16 were returned. 2 more questionnaires were not useable. Finally, we received 99 questionnaires which were more than 92 and could be used for a rational conclusion.

Table 4- 8. sampling population

Row	Name	Type	Available Experts No.	Received Questionnaires
1	Bank Melli Iran	Public	12	10
2	Bank Sepah	"	10	9
3	Bank Tejarat	"	10	1
4	Bank Mellat	"	11	5
5	Bank Saderat	"	7	2
6	Bank Toseie saderat	"	7	2
7	Bank Keshavarzi	"	12	9
8	Bank Sanaat va Maadan	"	7	2
9	Bank Refah	"	7	2
10	Bank Maskan	"	3	2

11	Post Bank	“	5	2
12	Bank Eghtesad novin	Private	12	10
13	Bank Parsian	“	15	12
14	Bank Karafarin	“	12	9
15	Bank Sarmaie	“	14	11
16	Bank Saman	“	18	3
17	Bank Pasargad	“	14	7

4.5- *Verification of model*

As we have mentioned earlier, testing of our perceived model will be performed in two steps. In the first step, we are going to test if logical relationship between components is as we have assumed or not. In this model which is a valid and frequently used model in BI literature, we can see that business intelligence can be determined by eleven components and these components can be grouped in three categories. This arrangement has come from Giovinazzo's model which we described earlier. Confirmatory Factor analysis has been chosen as a tool to study this issue. It has been used as a confirmatory tool to verify the number of factors and also assignment of structures to factors. In the second step, we are going to test that to what extent our model with its eleven components, explains the variability in the dependent variable, business intelligence and so to what extent it is able to determine business intelligence. For this purpose, we have used regression technique. The r-square adjusted which will be calculated then, will be an indicator of prediction power of the model. Results of Confirmatory factor analysis performed by SPSS software is as follows:

Table 4- 9. Extraction Method: Principal Component Analysis

Communalities		
	Initial	Extraction
Data gathering	1.000	.8
Data extraction	1.000	.5
Data transformation	1.000	.8
Data cleansing	1.000	.8
Data storage	1.000	.8
Data warehouse	1.000	.3
Reporting and dashboard	1.000	.8
Online analytical processing	1.000	.9
OLTP	1.000	.9
Data mining	1.000	.8
Business Strategist	1.000	.9
Extraction Method: Principal Component Analysis.		

Confirmatory Factor analysis is performed using principal component method. We have chosen to analyze correlation matrix and have loaded “three” as number of factors for analysis.

Table 4- 10. Total Variance Explained

Total Variance Explained									
Component	Initial Eigen values			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
Data gathering	4.2	39.0	39.0	4.2	39.0	39.0	4.2	38.2	38.2
Data extraction	3.5	32.0	71.1	3.5	32.0	71.1	3.5	32.5	70.8
Data transformation	1.0	9.1	80.2	1.0	9.1	80.2	1.0	9.4	80.2
Data cleansing	.8	7.4	87.6						
Data storage	.5	5.1	92.8						
Data warehouse	.2	2.6	95.5						
Reporting and dashboard	.1	1.6	97.1						
Online analytical processing	.1	1.1	98.2						
OLTP	.09	.8	99.1						
Data mining	.05	.4	99.6						
Business Strategist	.04	.3	100.0						
Extraction Method: Principal Component Analysis.									

Figure 4-^Λ . Scree Plot

Scree plot as it is shown above, obviously confirms number of factors which we had assumed as being three. As for rotation method, Varimax is used. Rotated component matrix shows factor loading for each variable. In each row, factors that each variable loaded most strongly on are highlighted. In sixth row a lighter loading is observed.

Table 4- 11. Rotated component matrix

Rotated Component Matrix			
	Component		
	1	2	3
Data gathering	.9	-.00	-.1
Data extraction	.6	-.1	.08
Data transformation	.9	.05	-.1
Data cleansing	.9	.06	-.1
Data storage	.9	.06	-.07
Data warehouse	.5	.1	.2
Reporting and dashboard	.07	.9	-.03
Online analytical processing	.00	.9	-.02
OLTP	.00	.9	-.00
Data mining	.00	.9	-.00
Business Strategist	-.07	-.05	.9
Extraction Method: Principal Component Analysis.			
Rotation Method: Varimax with Kaiser Normalization.			
a. Rotation converged in 4 iterations.			

As we mentioned earlier, factor analysis has been used to find out to what extent our grouping of components is compatible with patterns of correlation among components. We have assumed they can be grouped in three categories so we would expect factor analysis to confirm the three factor arrangement as a suitable one. As it is obvious from Total Variance Explained table and also from Scree plot, three factor arrangement is recommended. Rotated component matrix also shows the grouping.

Because we had numbered components according to perceived categories, it is not surprising to see they have been groups in the sequence. So based on results of factor analysis, which is a data reduction technique, further studies can be reliably focused on this three factor model.

4.6- Testing the prediction ability of model

Regression analysis has been used to verify that business intelligence can be well explained and its level estimated based on the three factors identified in the factor analysis section. For each factor, the average value of its components (structures) is considered as its score. So, there will be three independent variables (factors) and one dependent variable (BI score). Results of analysis are as follows:

Table 4- 12. Model Descriptive Statistics

Descriptive Statistics			
	Mean	Std. Deviation	N
Business Intelligence	1.6	.5	99
Acquire the data	1.5	.5	99
Analyze the data	1.7	.7	99
Take action based on the data	2.1	.9	99

Table 4- 13. Model summery

Model Summary										
Model	R	R Square	Adjusted Square	R	Std. Error of the Estimate	Change Statistics				
						R Square Change	F Change	df1	df2	Sig. F Change
1	.8	.7	.7	.2		.7	81.6	3	95	.000
a. Predictors: (Constant), Take action based on the data , Analyze the data , Acquire the data										

Table 4- 14.Statistical Model Testing

ANOVA^b						
Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	17.8	3	5.9	81.6	.00
	Residual	6.9	95	.07		
	Total	24.7	98			
a. Predictors: (Constant), Take action based on the data , Analyze the data , Acquire the data b. Dependent Variable: Business Intelligence						

Coefficients^a						
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.07	.1		.5	.5
	Acquire the data	.5	.04	.6	11.0	.00
	Analyze the data	.3	.03	.5	10.5	.00
	Take action based on the data	.04	.02	.09	1.6	.09
a. Dependent Variable: VAR00004						

Model summary table shows that adjusted r square is 0.712 which can be considered an acceptable value considering the nature of the subject. Every possible effort has been considered to make interviewees well understand the concept of business intelligence. Such understanding will help them to identify a well-thought score for total value of business intelligence in which they have paid enough attention to every aspect of business intelligence. However, many of them -if not all of them- had been familiar with the concept of business intelligence and the right way for its establishment, so they had their own definitions of business intelligence components. This may have been responsible for introduction of some error which can not be easily avoided.

4.7- analysis and results

For gathering the needed data we used a structured questionnaire which is verified for being valid and reliable. As we mentioned in second chapter, the model which is used for the BI processes modeling is as below. Therefore we just need to know what is the maturity level of these processes in Iranian Banking industry, which is appraised by the defined questionnaire.

Table 4-۱۵ . Model variables

Factors	Construct
Acquire the data	12. data gathering 13. Extraction 14. transformation 15. cleansing 16. data storage 17. data warehouse
Analyze the data	18. reporting & dashboard 19. Online Analytical Processing 20. OLTP 21. Data Mining
Take action based on the data	22. Business strategist

For measuring the maturity level of BI processes we used the leveling method of CMMI. The description of these levels is as follows:

4.7.1- CMMI Maturity Levels

A maturity level is a precise picture of process growth. Each maturity level alleviates an important part of the organization's processes. Maturity levels consist of a predefined set of process areas.

The maturity levels are measured by the realizations of the goals that apply to each predefined set of process areas. The model consists of five maturity levels, each layer being the basis for continuing process improvement:

- Initial. Process unpredictable, poorly controlled, and reactive. (The value is in the 0-0.5 interval)
- Managed. Process characterized for projects and is often reactive. (The value is in the 0.5-1.5 interval)
- Defined. Process characterized for the organization and is proactive. (The value is in the 1.5-2.5 interval)
- Quantitatively managed. Process measured and controlled. (The value is in the 2.5-3.5 interval)
- Optimized. Focus on process improvement. (The value is in the 3.5-4 interval)

Each process and sub process is considered and assessed according to CMMI maturity levels. For doing this, as we mentioned before, we used a structured questionnaire. For each question, we used a 5-point scale (from 0 to 5) which is derived from maturity levels defined by CMMI. Here are the results for each process and sub process.

The process; phase one, acquiring the data

In the presented model, the phase one is acquiring the data that begins with the operational environment. William A. Giovinazzo in his book introduces the phase one as following, Data is extracted from this environment and stored in the data warehouse. As the data is piled up, it is cleansed and transformed so that it can be mixed with the other data in the warehouse. The warehouse is some central repository of data, which is separated from the operational data.

Data from outside the data warehouse pours into the BI loop from the operational environment. These are information about customers, suppliers, competitors, products, and the organization itself.

When data extracted from the operational environment, it cleansed and transformed, in order to become more consistent with the data in the warehouse. It is then stored in some central warehouse. This central repository can be either a multidimensional or a relational database.

Figure 4-4 . Radar chart for process one

- **Data gathering:** is the process of gathering the data from different sources. The data in Iranian banking industry gathered through POS, ATM machines, e payment, and from clients and this process done systematically and automatically.

- **Data extraction:** The extraction engine receives data from the operational environment. Transportable tables and data reproduction are examples of alternative techniques for moving data into the warehouse. This is not in good situation in Iranian banking industry because there is not any automatic process, and neither the specific software, also they have not the required knowledge about physical model database.

- **Data transformation:** Scrubbing consists of data transformation and cleansing. Data transformation is the process of converting data from different systems and different formats into one consistent format. The statistics unit in banks transforms the data to the field that different groups need and implement the required changes on it. Moreover, this transformation done through different applications, which are not, integrated enough.

- Data cleansing: Data cleansing is the process of removing errors from the input stream and is part of the integration process. The data cleansing in financial systems is done at least twice a year (at the end of the first 6 month of the year and the end of the year). There is defined process for this activity. However, this precision is done just for financial data not the others.
- Data storage: The data store contains the raw data of the data warehouse. The central data store can be either a multidimensional database or a relational database system. The data storage in Iranian banking industry will be done automatic totally and with great hardware. The process will be controlled regularly, monitoring is done every 24 hour, redundancy, and backup recovery is considered completely.
- Data warehouse: W. H. Inmon defines the data warehouse as "a subject-oriented, integrated, nonvolatile, time-variant collection of data in support of management's decisions." In Iranian banking industry there is not a unique and integrated data warehouse, which can answer the needs for queries, they do this activity by different tools for different applications.

The process; phase two, analyzing the data

DSS is the next step in the loop. DSS regains data and presents it to the decision maker. We often conceive DSS as a multidimensional tool that is a compound, advanced system. Also we assume simple reporting as DSS. In fact, DSS is a full field of systems, ranging from reporting through Online Analytical Processing (OLAP) to data mining.

Figure 4-۱۰ . Radar chart for process two

- Reporting & dashboard: The enterprise-reporting tool should make it as straightforward as possible to get the data to business person who may want it. For this reason, an enterprise reporting tool should have the following capabilities:

- "Rapid Development- the tool should provide a wizard to walk the developer through the creation of the report. It should also allow the developer to view the report exactly as it will be seen."

- "Easy Maintenance— the tool should allow the user to modify reports through a wizard."

- "Easy Distribution— the report engine should be able to direct the same report or portion of a report to different media. For example, a portion of a report could be posted to a Web site, while another section is sent to management via email, and a third is sent via standard mail to stockholders."

- "Internet-Enabled— the reports server should be able to receive requests from both Web-based and non-Web-based clients."

In case of Iranian banks, there is not any integrated system for extracting any report from that, in addition the managers themselves have not the required information on that the data should be reported in which figure. There are systems in some private banks that they extract card switch transaction efficiency information from that.

- Online analytical processing: acquiring OLAP, the decision maker's analysis cooperates with the data surrounded within the system. It forces the time-variant characteristics of the data warehouse to allow the strategist to look back in time as well as

into the future. In looking back, the strategist can recognize approaches that may be concealed in the data. In looking forward, these trends can be used to forecast future conditions. In addition, the characteristics of these trends can also be examined. The strategist can predict how probable changes in these trends will affect the organization's environment.

OLAP permits the user to present the data in multiple dimensions. OLAP must be able to present data in multiple dimensions at time.

In Iranian banks there are not specific analytical processes, but analyze in the banks is done by statistical tools or by managers according to the reports.

- Online transaction processing, or OLTP, refers to a class of systems that facilitate and manage transaction-oriented applications, typically for data entry and retrieval transaction processing. some believe a "transaction" in the field of computer or database transactions, while others define it in terms of business or commercial transactions. OLTP has also been used to refer to processing in which the system responds immediately to user requests. An automatic teller machine (ATM) for a bank is an example of a commercial transaction processing application. In Iranian banking industry they have the OLTP systems that is their main database and all the processes is doing online on the data, it should be monitored all the time and should updated regularly.

In Iranian banks the OLTP is the main database of bank which all of the transaction doing online on it, and it should work 24 hours a day and always updated. Some banks use oracle database.

- "Data mining: Data mining is the extraction and classification of data from databases.

The data as a whole seems to be nothing but a collection of random events. Data mining allows us to see the picture hidden within those events—color blind or not.

There are two basic types of data mining: classification and estimation. With classification, objects are segmented into different classes. In a marketing data warehouse, for example, we could look at our customers and prospects and categorize them into desirable and undesirable customers based on certain demographic parameters. The second type of data mining, estimation, attempts to predict or estimate some numerical value based on a subject's characteristics.

- Decision Trees

Decision trees are a common modeling technique that has been used since before data mining was developed.

- Genetic Modeling

Genetic modeling is well suited for categorizing. It comes from the concept of survival of the fittest—in this case, survival of the fittest model. "

The process: phase three, take action based on the data

The main factor of BI loop is decision maker. He receives information pulled out from the data warehouse and carried by the DSS to identify some plan of action. The operational location replicates the result of his or her decisions. These results are after that fed back into the data warehouse and another iteration of the loop begins again. Decision makers are just a piece of the BI loop like the other sections.

The decision maker is the key of BI loop. The decision maker takes information from the DSS and defines some course of action. Typically, we consider the decision maker as a member of the organization, a person who works within the company, and plans some strategy for the organization itself.

Our partners, customers and employees can be considered as decision makers

4.7.2- Over view of BI process maturity in Iran banking industry

The entire questionnaires have been considered and the average value calculated by using Microsoft excels software. For each level the following values is the output and the maturity score.

Figure 4-11 .Public and private banks maturity

As it is shown in the figure above all levels of the process are weighted 1.5 to 2.5 which means the BI process in Iranian banking industry is at the level three of capability maturity model. This means that the BI process is in **defined level**.

According to CMMI the level three (defined) means that the maturity of BI is as follows:

"A defined process is a managed process that is tailored from the organization's set of standard processes according to the organization's tailoring guidelines, and contributes work products, measures, and other process-improvement information to the organizational process assets. It means that banks has set of standard processes, in case of Business Intelligence which are the basis of the defined process, which are established and improved over time. Standard processes describe the fundamental process elements that are expected in the defined processes. Standard processes also describe the relationships (e.g., the ordering and interfaces) between these process elements. The organization-level infrastructure to support current and future use of the organization's set

of standard processes is established and improved over time. The organizational process assets are artifacts that relate to describing, implementing, and improving processes. These artifacts are assets because they are developed or acquired to meet the business objectives of the organization, and they represent investments by the organization that are expected to provide current and future business value. (Carnegie Mellon, 2001)

Because the process descriptions, standards, and procedures are tailored from the organization's set of standard processes and related organizational process assets, defined

Processes are appropriately consistent across the organization. Another critical distinction is that a defined process is described in more detail and performed more rigorously than a managed process. This means that improvement information is easier to understand, analyze, and use. Finally, management of the defined process is based on the additional insight provided by an understanding of the interrelationships of the process activities and detailed measures of the process, its work products, and its services."

4.8- ANOVA test

In this section, we want to test if different characteristics of responders may affect the results or not. In other word we want to find out if the responders sex, position, age or other characteristics may make the results different or not. This will assure us that different points of views or different characteristic has not influenced the results and it means that responders have not biased the results.

In this section, we want to check another issue too. Considering the influence of different characteristic of bank in their BI maturity level is another aim of this section. We want to find out if the characteristics like the banks size, age or possession have any affect on their BI maturity level or not. For testing these issues, we used the ANOVA (ANalysis Of Variance) test, which is illustrated below.

4.8.1- Responders

Sex

Hypotheses

$$H_0 : \mu_1 = \mu_2$$

H_1 : At least two groups are different

Table 4- 16. Test of homogeneity variances -Responder's sex

Test of Homogeneity of Variances			
MATURITY			
Levene Statistic	df1	df2	Sig.
.4	1	97	.4

Table 4- 17. Anova test -Responder's sex

ANOVA					
Maturity					
	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	.03	3	.01	.1	.9
Within Groups	8.02	95	.08		
Total	8.05	98			

p -value= 0.994 & α =0.05

since p -value is greater than α , we can't reject the null hypothesis, so we conclude that the sex of responders hasn't a distinctive affect on BI maturity.

Age

$$H_0 : \mu_1 = \mu_2 = \mu_3 = \mu_4$$

H_1 : At least two Age groups are different

Table 4- 18. Test of homogeneity variances -Responder's age

Test of Homogeneity of Variances			
Maturity			
Levene Statistic	df1	df2	Sig.
.065	3	95	.9

Table 4- 19. Anova test -Responder's age

ANOVA					
maturity					
	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	.03	3	.01	.1	.9
Within Groups	8.02	95	.08		
Total	8.05	98			

$p\text{-value} = 0.944$ & $\alpha = 0.05$

since $p\text{-value}$ is greater than α , we can't reject the null hypothesis, and because they are three items for better conclusion we implement tukey test.

Homogeneous Subsets

Table 4- 20. Post hoc-Responder's sex

Maturity		
Tukey HSD		
A,B,C,D	N	Subset for alpha = 0.05
		1
B	36	1.8
A	25	1.8
C	25	1.8
D	13	1.8
Sig.		.9
Means for groups in homogeneous subsets are displayed.		

As we can see all the four groups are in one subset for alpha. So there isn't any difference between groups in terms of BI maturity.

Education

$$H_0 : \mu_1 = \mu_2 = \mu_3$$

H_1 : At least two groups are different

Table 4- 21. Test of homogeneity variances -Responder's education

Test of Homogeneity of Variances			
Maturity			
Levene Statistic	df1	df2	Sig.
5.4	2	96	.006

Table 4- 22. Anova test -Responder's education

ANOVA					
maturity					
	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	.2	2	.1	1.3	.2
Within Groups	7.8	96	.08		
Total	8.05	98			

p -value= 0.254 & α =0.05

since p -value is greater than α , we can't reject the null hypothesis. so we run tukey test.

Table 4- 23. Post hoc-Responder's education

Maturity		
Tukey HSD		
		Subset for alpha = 0.05
A,B,C	N	1
A	56	1.7
B	32	1.8
C	11	1.8
Sig.		.4
Means for groups in homogeneous subsets are displayed.		

As we can see all the three groups are in one subset for alpha, which means there isn't any significant influence.

Position

$$H_0 : \mu_1 = \mu_2 = \mu_3$$

H_1 : At least two groups are different

Table 4- 24. Test of homogeneity of variances-Responder's position

Test of Homogeneity of Variances			
Maturity			
Levene Statistic	df1	df2	Sig.
.2	2	96	.7

Table 4- 25. Anova test -Responder's position

ANOVA					
maturity					
	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	.5	2	.2	.5	.5
Within Groups	51.8	96	.5		
Total	52.4	98			

$p\text{-value} = 0.5$ & $\alpha = 0.05$

since $p\text{-value}$ is greater than α , we can't reject the null hypothesis. so we run tukey test.

Table 4- 26. Post hoc-Responder's position

Maturity		
Tukey HSD		
exman,middleman,expert	N	Subset for alpha = 0.05 1
Exman	25	1.4
Expert	42	1.5
Middleman	32	1.6
Sig.		.5
Means for groups in homogeneous subsets are displayed.		

As we can see all the three groups are in one subset for alpha, which means there isn't any significant influence.

4.8.2- Banks

Possession

$$H_0 : \mu_1 = \mu_2$$

H_1 : At least two groups are different

Table 4- 27. Test of homogeneity of variances- bank possession

Test of Homogeneity of Variances			
Maturity			
Levene Statistic	df1	df2	Sig.
.001	1	15	.9

Table 4- 28. Anova test- bank possession

ANOVA					
maturity					
	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	4.3	1	4.3	2.1	.000
Within Groups	.03	15	.002		
Total	4.3	16			

$p\text{-value} = .000$ & $\alpha = 0.05$

since $p\text{-value}$ is smaller than α , we shall reject the null hypothesis. At the $\alpha \leq 0.05$ level of significance, there exists enough evidence to conclude that there is an effect due to bank possession.

Size

$$H_0 : \mu_1 = \mu_2 = \mu_3$$

H_1 : At least two groups are different

Table 4- 29. Test of homogeneity of variances-Bank size

Test of Homogeneity of Variances			
Maturity			
Levene Statistic	df1	df2	Sig.
58.2	2	14	.000

Table 4- 30. Anova test- Bank size

ANOVA					
maturity					
	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	1.9	2	.9	5.4	.01
Within Groups	2.4	14	.1		
Total	4.3	16			

$p\text{-value} = .017$ & $\alpha = 0.05$

since $p\text{-value}$ is greater than α , we can't reject the null hypothesis. Since they are three items we run tukey test.

Post hoc

Table 4- 31. Post hoc- Bank size

Multiple Comparisons						
maturity						
Tukey HSD						
(I)	(J)	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
small,medium,large	small,medium,large				Lower Bound	Upper Bound
small	medium	.008	.2	.9	-.6	.7
	large	.6	.2	.03	.0	1.3
medium	small	-.00	.2	.9	-.7	.6
	large	.6	.2	.0	.03	1.3
Large	small	-.6	.2	.0	-1.3	-.04
	medium	-.6	.2	.0	-1.3	-.03
*. The mean difference is significant at the 0.05 level.						

Table 4- 32. Tukey test- Bank size

Maturity			
Tukey HSD			
small,medium,large	N	Subset for alpha = 0.05	
		1	2
Large	7	1.1	
Medium	5		1.7
Small	5		1.7
Sig.		1.000	.9
Means for groups in homogeneous subsets are displayed.			

Here we can see that there are small differences between large, and small, medium sized companies. the size of company has an effect on BI maturity level. But there is an important consideration that may help us to understand this issue. All of the large banks are public held banks. As we studied earlier, private held banks are more mature in BI than public held banks, therefore we can not judge that this being more mature in BI is for being larger or for being private, because there is no large private bank that we can check this issue. Anyway, as the difference for p value is greater for Possession factor than for size factor and also by the information gathered by interview, it seems that possession is more affecting factor on BI maturity level than size.

Age

$$H_0 : \mu_1 = \mu_2$$

H_1 : At least two groups are different

Table 4- 33. Test of Homogeneity of Variances-Bank age

Test of Homogeneity of Variances			
Maturity			
Levene Statistic	df1	df2	Sig.
.001	1	15	.9

Table 4- 34. Anova test -Bank age

ANOVA					
maturity					
	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	4.3	1	4.3	2.1	.000
Within Groups	.03	15	.002		
Total	4.3	16			

$p\text{-value} = .000$ & $\alpha = 0.05$

since $p\text{-value}$ is smaller than α , we shall reject the null hypothesis. At the $\alpha \leq 0.05$ level of significance, there exists enough evidence to conclude that there is an effect due to bank age.

Chapter 5

Conclusions and Implications

Introduction

In this chapter, the research findings will be presented with attention to the collected data and statistical analysis. Subsequently, the necessary suggestions will be offered in two sections as suggestions based on research findings and suggestions for future researches.

5.1- *Innovative part of research or contribution*

Our research presents important theoretical and practical contributions. On the theoretical side, we provide a modified model for Business Intelligence process. The modification was done on the model which William A. Giovinazzo (2002) were introduced in his book, 'internet enabled Business Intelligence'. On the practical side, our empirical results provide a better understanding of the Business Intelligence and their relative importance in enabling the banking industry to be competitive. Also we used CMMI for measuring the BI process maturity level which has never done before and transforming it from being a theoretical model to a measurement tool in the organizations.

5.2- *Implications for theory*

The aim of this research was to evaluate BI process maturity level in Iranian banking industry, which we used the process in the William A. Giovinazzo's book and CMMI model. First of all, applying this model in BI field, specifically in Iran, was something that didn't happen before. We verified this model by some statistical tools and also by asking some subject matter experts and we reconfirmed the model. Therefore it means that this model is reconfirmed for banking industry and also in Iranian business context which is a developing country. Also, we used CMMI maturity definition and levels in BI model, and this could be a new tool for assessing the BI maturity level in different industry and specially in banking industry.

5.3- *Implications for managers*

As mentioned before, Business Intelligence process is used in a wide range of industries worldwide to use the organization's data for making decision in the best way. Gartner, Inc. (NYSE: IT) is the world's leading information technology research and advisory company predicts that By 2010, 20 per cent of organizations will have an industry-specific analytic application delivered via software as a service (SaaS) as a standard component of their BI portfolio.

It is essential for Iranian CEOs on top of the decision pyramid and its former and middle managers to know how and where to implement this new and useful technology.

Hopefully this research would be a guideline or a toolbox for them in order to access their needs and priorities in this path.

Meanwhile so many Banks have already started using Business Intelligence in their needed applications. But they aren't aware about their needs in this case and don't know their strength and weaknesses. With this research they can be more familiar with BI process and arrange better strategies for implementing BI process in their organizations.

5.4- Implications for Future Research

According to this research and also my own final goal, future research could be done on evaluating Critical Success Factors for the implementation of Business Intelligence in Iranian banking industry.

In recent years Business Intelligence has been used in some areas in Iran such as banking industries, but there isn't any framework for all banks and they haven't any specific strategy.

5.5- Limitations

The limitations for present research are that;

In view of the fact that our time and resources were limited,

- Our sample was just banking industry, not all Iranian industries.
- There wasn't a good knowledge of Business Intelligence in Iranian Banking industry
- Our gathered data was not census data , rather it was sample data
- Some of the banks managers didn't answer the questions well

5.6- ANOVA test

for comparing the constructs regarding bank characteristics and responders characteristics we run ANOVA test. Analysis Of Variance indicates that the characteristics of responders such as sex, age, education and possession don't influence any of constructs. The results show that the characteristics of responders don't influence on their perceptions of BI maturity in their banks. BI tools are specific systems that are

the same in every expert's views. But the results show that the bank characteristics have an influence on Business Intelligence maturity level. As we can find out from the results, the possession on the banks in term of public and private has a significant effect on maturity of BI .in private banks the Business Intelligence is more mature than in public banks. In addition the size of company is the other item which influence on BI maturity level, we divided the banks in three groups based on their number of branches, the banks with fewer branches (small & medium sized) are more private ones so have more automated systems in case of BI. And about the age of the companies, the reason could be as simple as that; the more new and more adapted with technology the banks are, the more they might have accepted the technology .because the IT have been faced with astonishing development in recent years, so the newer banks run the newer systems and feel the need of new technologies more sooner than the older banks.

5.7- Discussion and conclusion

According to the results derived from the questionnaires, we find out that the maturity level of BI as a whole process in Iranian banking industry is at level three. It means that we have some defined processes for doing BI in this industry. In other words, A defined process is a managed (capability level 2) process that is tailored from the organization's set of standard processes according to the organization's tailoring guidelines, and contributes work products, measures, and other process-improvement information to the organizational process assets.

BI includes three main process of acquiring the data, Analyze the data, take an action based on the data. Each of them has a specific maturity level which can be useful to understand the whole problem.

- **Acquiring the data:** according to results derived from the questionnaires, the maturity level of this process is at three. It means there are some defined processes for that. But if we consider it in more details we find out that data gathering and data cleansing and somehow data storage sub processes are better defined and applied. But data extraction and data warehouse sub processes are at level 1 and they need to be defined and be more at consideration.

- **Analyze the data:** analyzing the data which are acquired is more applied. In other words most of the sub processes are well defined and applied. The worst sub process is data mining which needs more attention.

- **Take action based on the data:** In almost all banks, there is a independent unit for analyzing and taking actions based on analyzed data. There for we can see a defined and almost used in practice processes which are established in these banks. The maturity level of this process is also three.

There is significant difference between private and public holds banks. As the results show, private banks are using a more mature BI process in caparison with public ones. In all processes and sub processes these fact is valid.

Other important information which can be derived from current research is that what we understood the worst BI sub processes in this industry. In fact, we can sort sub processes by their maturity level to find out this issue.

Figure 5-۱ . Business Intelligence maturity level base on its constructs

According to Pareto's law, we should consider on the most important factors. Therefore we suggest that for improving the maturity level of BI in Iranian banking industry at first we should improve data ware house, extraction and OLP capabilities.

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Appendix

Questionnaire

Questionnaire for investigation the usage of Business Intelligence tools

This questionnaire has been designed to gather valuable information from IT experts, IT managers or key persons of banks regarding company's needs in relation to BI systems and tools. This information will help us to understand companies' needs and the level of their usage of BI tools. In order to improve the usage of BI systems and tools that can fulfill the company needs.

In this survey we consider BI as a process which includes three phases, which are:
Acquiring the data, analyzing the data and take action based on the data.

Each process and sub process is considered and evaluated according to CMMI maturity levels. For each question we used a 5 point scale (from 0 to 5) which is derived from maturity levels defined by CMMI.

- Initial. Process unpredictable, poorly controlled, and reactive. (0)
- Managed. Process characterized for projects and is often reactive. (1)
- Defined. Process characterized for the organization and is proactive. (2)
- Quantitatively managed. Process measured and controlled. (3)
- Optimized. Focus on process improvement. (4)

Bank's profile:

Is your organization public or private?

.....

Which organizational level do you represent? (Strategic level: CEO, top managers, or business level) Please include your position in the organization.

.....

You are male ☐ female ☐

.....

Data gathering

Do the data gather completely from all sources (ATMs, POS, ...) in your bank?

0	1	2	3	4
---	---	---	---	---

.....

Do you have an automated system in your bank for data gathering?

0	1	2	3	4
---	---	---	---	---

.....

Data extraction

Do you have automated extraction tools in your banking system?

0 1 2 3 4

How completely the data extraction process is done in your bank?

0 1 2 3 4

Data transformation

Do you have an effective data transformation process?

0 1 2 3 4

Is the data transformation process automated in your bank?

0 1 2 3 4

Data cleansing

Do you have automated cleansing tools in your banking system?

0 1 2 3 4

How completely the data cleansing process is done in your bank?

0 1 2 3 4

Data storage

How effectively the organization stores the data?

0 1 2 3 4

Data warehouse

Is your warehouse administration infrastructure completely automated? And which types of data warehousing you use?

0 1 2 3 4

Do you have an integrated system for data warehouse in your bank?

0 1 2 3 4

Reporting & dashboard

Does the organization have the capability of monitoring important sources of information now?

0 1 2 3 4

Are alerting techniques used to communicate exceptions quickly so decisions are accelerated?

0 1 2 3 4

Are continuous monitoring processes in place to allow alerts to be communicated immediately to those who need to take action?

0 1 2 3 4

Online analytical processing

Do you have an integrated system for analyzing all sorts of data?

0 1 2 3 4

Is your database tuning frequently? In specific time intervals?

0 1 2 3 4

OLTP

Are your OLTP software answers your transactions in branches and switch card?

0 1 2 3 4

To what extend can your bank do the transactions online?

0 1 2 3 4

Data mining

Have you established a propriety information protection plan to safeguard your company's private information and has your business clearly outlined its expectations regarding information protection to its employees?

0 1 2 3 4

How effective is your data mining process?

0 1 2 3 4

Business strategist

To what extend the decision making process is automated in your organization?

0 1 2 3 4

How do you evaluate the Business Intelligence process in your organization?

0	1	2	3	4
---	---	---	---	---

.....

Functionality:

Which of the following functionalities should a Business Intelligence tool include?
(Please order from the most to less important)

- ☐ OLAP analysis
- ☐ Executive information Systems
- ☐ Score carding, dash boarding, and data visualization applications
- ☐ Assessment (surveys for employees satisfaction)
- ☐ Data warehouses
- ☐ Data mining
- ☐ Decision support systems
- ☐ Reporting and analysis tools
- ☐ Management information systems or administrative resources
- ☐ Best-practice models
- ☐ Business analysis applications
- ☐ Business performance management
- ☐ Communication(intranet ,internet forum)
- ☐ Document warehouse
- ☐ Text mining applications
- ☐ Knowledge management features
- ☐ Global information systems
- ☐ Other(please mention)

Characteristics of BI tools:

Which of the following characteristics are the most important ones for a BI tool? (Please order from the most to the least important)

- ☐ Low total cost of ownership(maintenance)
- ☐ Capability of connecting with other existent components
- ☐ Support industry standards, e.g. XML, XML for analysis (XMLA), OLE DB for OLAP (ODBO), java 2 platform enterprise edition (J2EE), JDBC interfaces etc...
- ☐ Extensible and adaptable to changing business needs (tools and interfaces for enhancing and extending existing business content or integrating with third party analysis and reporting tools
- ☐ Personalization (users can personalize contents and the way they access it while complying with each company's security policies)
- ☐ Other(please mention)