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Abstract

Issues that emerged from the use of the document management system and the desire to change to a database management system (DBMS) by many organizations is the driving force behind the ideas from this thesis. Draga AS identified the challenges arising from this shift and provided the basis for this work. The goal is to present a review of the relevant bibliographical material that illustrates those critical factors that both affect and are affected by this change.

This study reviews seven different challenges that need to be considered when shifting to DBMS: The first challenge is to examine the role played by human psychology in relation to change. The second challenge focuses on DBMS-specific challenges in relation to today's requirements. Next challenge discusses the elements that ensure that the work process receive the benefits that emanate from the application of the system. The fourth challenge reviewed looks at the risks associated with the transition. The fifth challenge reviewed discusses the importance of the various resources required. The sixth challenge reveals the crucial parts that need to be taken into account in the planning and implementation procedure. The final challenge reviewed discusses how to successfully manage the legacy data and information.

Research showed that the best way to manage employees' resistance for the new system is to develop a change management tool. This is comprised of a number of key elements, namely, the performance management process, ensuring that the necessary skills are applied. It is also important to provide adequate training as well as a plan of effective communication and positive reinforcement to ensure that the obstacle of resistance is transcended. In addition, today's requirements demand from the DBMS professionals that they fully understand the transition to a multi-application database platform. Database design and software development must be applied in a manner that will ensure the work process continues to function smoothly. A necessary prerequisite for this transition to be successful is that the organisation must address the obstacle(s) which risks entail. This is carried out through the development of a risk strategy that meets the organization's requirements and strengths security controls on a continuous basis. The project cycle framework is a useful tool that provides an integrated, cost-effective and timely planning and implement procedure. Finally, with respect to managing legacy data, what needs to be considered is developing a data migration strategy that requires a set of technical applications and people with skills, supported by all the appropriate tools.

The overall results lead to the recommendation for a scenario-based approach to strategic planning that would include all challenges in a series of activities.

Acknowledgments

This thesis is submitted as the mark of completion for the degree of Master of Science in Offshore technology, specialized in Industrial Asset Management at the University of Stavanger.

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I am very grateful to my supervisor, Professor Knut Erik Bang, for his constant support and valuable contribution to this masters thesis. I would also like to thank Professor Jayantha Prasanna Liyanage who has trusted me with this particular subject.

I am very grateful that I had people around me who have supported and motivated me throughout the entire period of this masters thesis. I would especially like to thank Jacob Yiacoumi for his assistance to complete this thesis.

I dedicate this master thesis to my family. To my father, my sister, and to my life's role model, my mother.

Stavanger, June 2017

Irene Siali

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Abbreviations

DMS	Document Management System
DBMS	Database Management System
EHR	Electronic Health Records
CM	Change Management
PM	Performance Management
TMP	Talent Management Process
EI	Emotional Intelligence
DBA	Database administrators
HIS	Human System Integration
HCI	Human Computer Interface
BI	Business Intelligence
SQL	Structured Query Language
IMS	Information Management System
IT	Information Technologies
DAL	Database Access Language
PMP	Project Management Plan
PCF	Project Cycle Framework

Chapter 1 Introduction

Data is, if not the most valuable, certainly one of the most valuable resources for organizations today. But what is data? Data is basically the simple facts and statistics collected through the operation of an organization. Many internal and external activities carried out in an organization use data to measure and record results. Data alone does not provide essential information, but it is the basis for information about a company's activities, and is therefore critical to all organizations. Thus, information is the data presented in a comprehensible way, enabling organizations to know what is happening in their businesses and to assist them in the implementation of significant decisions (Sirianni, 2017).

The majority of organizations today are using a document management cantered approach to manage their information. However, this approach lead to the use of documents as databases and as a result generated problems with the greatest of these being the creation of data silos, a large number of data entry points and a waste of time and effort (Fuqua, 2012). Organizations are currently facing strong pressures to find ways to better manage data, while limiting the consequences of changing the data system. The solution to this problems is coming through the data management cantered approach, which manages the data more efficiently and allows users to perform multiple tasks with ease (Aveda, 2015). The new systems being developed or implemented need to be functional, easy to use, while protecting data and information from mistakes and breaches (Dhingra, Jain, & Jadon, 2016).

Shifting to a data management approach is challenging, but it is absolutely necessary for many organizations. Challenges which arise should be addressed by creating strong decision-making methods and tools to support the conversion process. Planning the entire conversion process should take into account in advance all those elements that affect and are affected by the change, in this way maximizing the system's success and reducing any negative effects or uncertainties associated with implementing the new system. The organization that makes this change appoints a conversion team responsible for the conversion process throughout the transition period from one system to another and allocates the necessary resources required to successfully implement this process, thus reflecting the significance of this change (Dinh et al., 2010).

The idea for this master thesis comes from a local data management company called Draga AS. The company provides full brownfield and project support, information management solutions

and services to organizations (Draga, 2017). The biggest issue many of its clients face today, is converting from the document management system (DMS) into database management system (DBMS), reducing as much as possible any negative causes emanating from this transition period, while at the same time addressing the challenges that arise in a wise and conscientious manner.

1.1 Objective

This master thesis is offered to me by Draga AS. It is to assist the company in understanding the challenges arising from the conversion from DMS to DBMS and to help and support organizations in developing a data conversion methodology.

The first and most important challenge given by the company is to identify the reasons that lead workers and leaders to resist change and by providing solutions and methods of how an organization can cope with the transition to the new technology.

For the second challenge I was asked to analyse and to determine the main 'today's' requirements arising from organizations using DBMS and how they can be approached by DBMS professionals. To discuss all the critical elements, which are important to ensure that work processes are meeting and realizing the benefits of a DBMS approach is the next challenge that needs analysis.

Draga AS wants this project to include a chapter setting out threats and risks during the implementation phase of a DBMS, as well as a mini-evaluation of existing security controls, providing actions that can be applied to improve these controls. In addition, the types of resources that will be required, is an important consideration when a DBMS is to be established, and this thesis will be providing an overview of these resources.

I have been asked to present an outline of a way of planning and implementing for an effective move from DMS to DBMS including the crucial factors that need to be considered if this is going to be a successful conversion project. Lastly, the request made was to provide an efficient, general way of managing legacy data and information from the old system (DMS), which can be adjusted to the needs of each organization.

1.2 Scope

Through this master thesis, we will seek to understand separately each challenge that arises when an organization goes from DMS to DBMS, presenting recommended solutions that will help to meet each challenge. Particular emphasis will be placed on the first challenge, human

psychology during the transition process, as the company requested. Each challenge will be analysed in a general way so that it adapts to the needs and requirements of each organization, and not to any specific organization or industry.

1.3 Methodology

The methodology is tailored to the needs of each challenge. It begins by researching the reasons why this aspect is of considerable importance and continues by providing an effective approach to addressing this challenge. However, the objective is to follows a general guideline based on the scientific method, which as figure 1 shows includes observation, hypothesis, design/perform and conclusion. First, the challenge will be observed, then the challenge shall be stated and a review made of the relevant research literature. The best solution(s) is selected and presented. And finally, the selection (results) will be discussed. But, the fact that greater weight will be given to some challenges and less to others in accordance with the company's requirements, nevertheless the methodological approach is adapted accordingly.

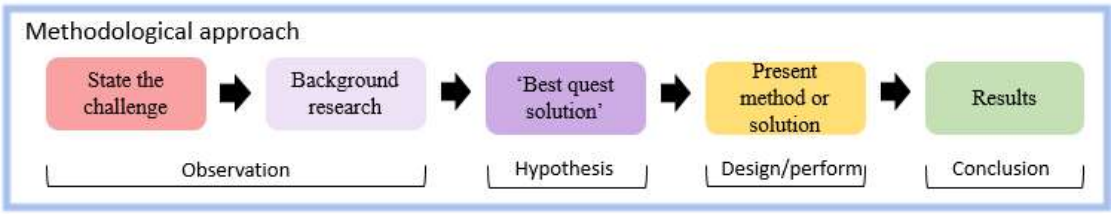

Figure 1 *Thesis methodological approach*

As each challenge is analysed it is essential to keep in mind the objective of this thesis. This objective is, to present each challenge in a way that will aid Drage AS to support its clients in a data system change process, and more specifically from DMS to DBMS.

1.4 Limitations of the study

This thesis does not portray a case study based on a real or hypothetical situation to see in practice the appropriate way to address these challenges. Instead, it looks for hypothetical solutions or methods based on bibliographical research. Moreover, in addition to health care, which has made the transition to electronic health records (EHR), all other industries are currently involved in the process of implementation, and so it is difficult to find a lot of information about this conversion. In addition, what is also discussed in this thesis relates to the transition from the DMS to DBMS, and the main focus is on how to implement the new reality, taking into account the practical issues that may arise. Finally, due to the nature of the topic of DBMS, it is important to follow the current advances as they evolve and therefore it is

of the utmost importance that information be constantly updated. As such, the majority of information comes from webpages.

1.5 Thesis structure

After this introductory chapter, the structure of this thesis contains 10 additional chapters as follows:

Chapter 2 provides the literature survey relevant to this thesis topic by describing the two systems, the problems that lead to change and determining where this thesis will concentrate.

Chapter 3 presents human psychology during a change, the reasons for resistance to change, and the way organizations have to deal with it.

Chapter 4 displays the key challenges for the DBMS with current requirements and ways that this can be managed.

Chapter 5 studies the appropriate approach to the DBMS in order to ensure the efficiency of the work process.

Chapter 6 identity implementation DBMS's risks and understanding and assessing the effectiveness of existing security controls.

Chapter 7 presents the resources required for the DBMS.

Chapter 8 recommends a way of planning and implementing the project.

Chapter 9 presents a systematic way to successfully migrate legacy data and information.

Chapter 10 provides a suggested proposal for better understanding the conversion to the DBMS process and provides also some small helpful tips.

Chapter 11 presents the conclusions of this thesis.

Chapter 2 Literature Review

Correspondence, contracts, invoices, estimates, receipts and reports are only some of the types of documents which a company has to 'face'. A document operates as proof of inside and outside information and activities. A huge amount of documents can confuse a company's employees as to how to manage all of them.

Documents are an important component in the smooth operation of a company. A correct and appropriate manner of using them, is absolutely essential. The demand to manage documents leads to a continual integration of the way companies need to be doing it. From shifting paper documents to electronic documents via computer and following on from this via server, documentation goes through three levels:

First level, the use of *physical paper* and only. Documents, file folders, filing cabinets and reports cavers, using paper in all levels and types. This method is not used any more by most companies or at least, not in the full version of it.

Second level, is the *electronic document* created and stored on desktop computers and shared via email. It is an option that applies mostly to most small and medium-sized businesses.

Third level, and most common type of documentation nowadays which many medium and most large businesses are using, is the *document management system.* All document management software have common features like: storing, managing, securing, and keeping track of the electronic documents and electronic images of paper based information captured through the use of a document size and sharing them via server which is accessed over the internet.

2.1 Document management system (DMS)

DMS is not only software which controls and organizes documents throughout a company, but also incorporates document and content capture, workflow, document repositories, COLD/ERM, and output systems, and information retrieval systems. Figure 2 show an example of how DMS works. Some of the key feature of DMS as illustrated by the Aiim (2017) webpage, includes:

- Check-in/check-out and locking, to coordinate the simultaneous editing of a document so one person's changes do not overwrite another's;

- Version control, so tabs can be kept on how the current document came to be, and how it differs from the versions that came before;
- Roll-back, to "activate" a prior version in case of an error or premature release;
- Audit trail, to permit the reconstruction of who did what to a document during the course of its life in the system;
- Annotation and stamps.

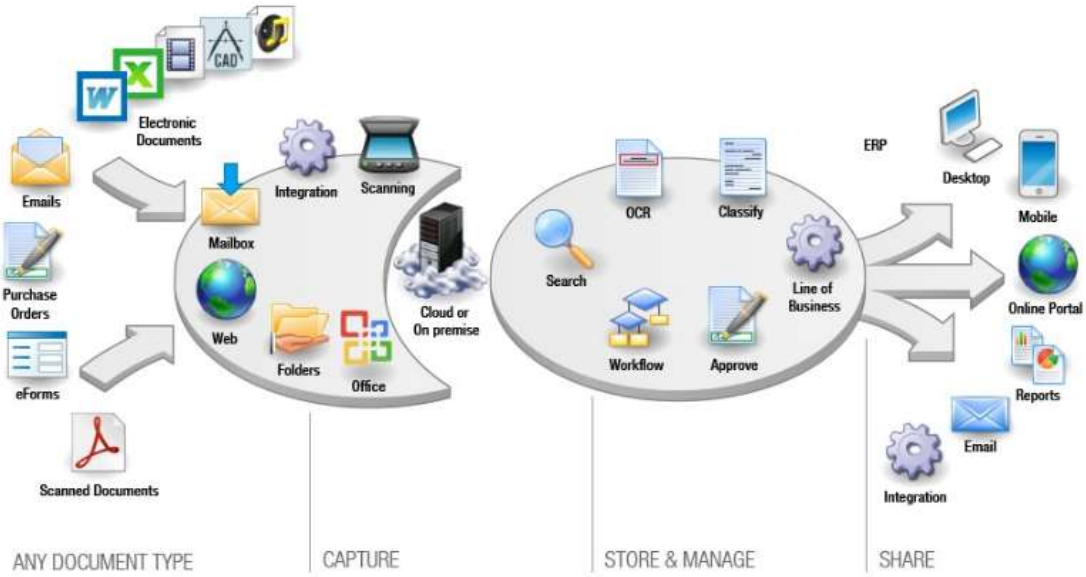

Figure 2 *Example of how a document management system works (Kazz, 2015)*

2.1.1 Problems of DMS

Every new level was an integration of the previous one. Improving the documentation process of an organization. New technological advances are the force to the next level each time. Solving problems and omissions of the previous one in order to make it more reliable, easier to use and safer than the previous one. The nowadays requirements show many omissions and raise challenges for the DMS, the solution of which are mandatory. The three main problems as mentioned by Fuqua (2012), can be divided into:

Data silos: Documents include a lot of data. However, this data is locked in these documents. Always when a new check and roles is added to the system, it creates a new small database file from each of your documents. These databases are disconnected as a result of the creation of data silos, these data are cut off from one another. To see the data, you need to see the document. To edit the data, it is necessary to edit the document. To reuse the data in another document, it

should reformat the data or copy and paste it. To use specific data in a mobile app, only if it downloads a copy. No filter, sort or query of the data in multiple documents.

The more documents the organization has, the more data silos. Documents that include many unrelated items, lead to unnecessary errors and a waste of energy and time. The more documents are added to the system, the deterioration multiplies.

Large number of data entry points: When new data comes out, a new document is created and added in the system. But this document, reproduces data from another document. This creates mistakes and error chances, as well as difficulty in the process of changing data. When data changes occur, all documents in which this data is located should be changed by developing a large number of values for the same data in different documents.

*Waste of time and effort***:** Unnecessary data entry and waste of search effort are necessary when a DMS runs in a company. All this waste of time and effort can deprive a company of development and expansion or, even worse, destroy new organizational procedures.

The large amount of information in an organization, transforms the DMS in a documents database, making it more complicated and costly. An individual has the availability to entry documents, important but also needless in the system, sometimes saving documents in his/her own computer or no transfer paper document in the system or double filing, when damage occurs paperwork can be destroyed, information is spread in the system, as a consequence employees spend a lot of time searching for something that may never be found, slow customer correspondence. These are only some of the DMS problems. Large organizations must find ways to face these problems and solve them. The solution is to pass to the next-four level, and that is, the *data management systems*.

2.2 Database management system (DBMS)

A good characterization about a document as illustrated by Fuqua (2012), is as a snapshot of data at a specific point in time. A document includes for example, prices of a specific period of time, and you wish that prices do not change when the prices change, instead that they continue to reflect the data inserted at the time the document was generated. However, if you want the document to change when changing data, it should not be in a document, but a data view in a database that will automatically change the data. This can be achieved by using DBMS.

2.2.1 What database management system does

A DBMS is system software for creating and managing databases. The DBMS provides users and programmers with a systematic way to create, retrieve, update and manage data. A DBMS makes it possible for end uses to create, read, update and delete data in a database. The DBMS essentially serves as an interface between the database and end users or application programs, ensuring that data is consistently organized and remains easily accessible (Rouse, 2015).

A DBMS gives the possibility to the users to view, upgrade, create and delete data in a database, in an organized, safe and easy manner. Handles the data, the database engine, and the database schema. Inside of these three elements, it ensures simultaneously, security, data integrity and uniform management processes.

DBMS provides data which may be accessed from many users from different locations in a secure and controlled manner. Every user has view only in the data which has been authorized by the organization as well as how that user must view the data, offering multiple views of a single database schema. Provides logical and physical independence, protecting both end-users and applications from knowing where the data is stored or that they should be concerned about changes to the physical data structure. This has been expressed by Rouse (2015). Figure 3 illustrates an example of how a DBMS works.

Figure 3 *Example of how a database management system works (Grigg, 2017)*

2.2.2 Types of DBMSs

The more famous DBMSs in the market as Rouse (2015) presents, are:

Relational database management system (RDMS): adaptable to most use cases, but RDBMS Tier-1 products can be quite expensive.

NoSQL DBMS: well-suited for loosely defined data structures that may evolve over time.

In-memory database management system (IMDBMS): provides faster response times and better performance.

Columnar database management system (CDBMS): well-suited for data warehouses that have a large number of similar data items.

Cloud-based data management system: the cloud service provider is responsible for providing and maintaining the DBMS.

2.2.3 Benefits of DBMS

DBMS is a nicely organized electronic filing locker where strong software aids to handle the contents of the locker. The benefits that an organization has in running a DBMS are many. The most important of these are presented below as Equizine (2012) webpage illustrated:

- *Data sharing*: The DBMS environment offers end-users better access to more and better managed data, allowing faster responses to changes in their environment;
- *Security data*: When the number of the user who enter the system is large, the risks of violence is higher. DBMS offer to the organizations a better implementation of security and data protection policies;
- *Better integration*: Organizations have a better view of the results of their activities due to the best way of managing the data. DBMS allows to understand, how and which activities affect each other;
- *Less inconsistent data*: There is no data coherence and consistency loss because there are no different versions of the same data that appear in different locations;
- *Better access*: The DBMS allows for rapid response to ad hoc queries. A query in a database is a specific request that is issued to DBMS for data processing;
- *Decision making aid*: Better data management and access to data make it possible to create better quality information where decisions are based;
- *Stronger worker productivity:* Data availability, in a combination with tools which change data into useful information, gives the ability to the end-users for faster decisions that can bring the organization ahead of the main competition.

2.3 Challenges in DBMS implementation

Effective implementation of DBMS is not an easy process. The transition period will take a long time and final implementation would be very hard to achieve. Many challenges should be confronted before initiating the change program, so as to be able to manage problems that will arise during the implementation time and during the system's life-cycle process. This thesis presents the main challenges that an organization has to face if it wishes to improve its technology management system. Every company should approach that challenges according to their requirements and procedures of operation. The challenges include the challengers to the employees' approach in an ongoing transforming work environment, challenges with today's requirements, ensuring work process, determination of implementation risks and assessing existing controls, resources needed in DBMS, planning and implementation approach and a way to manage the legacy data and information.

Chapter 3 Human Psychology

The first challenge faced by an organization in implementing DBMS is human psychology. Employee psychology, as shown in figure 4, goes through many stages until it fully accepts the upcoming change.

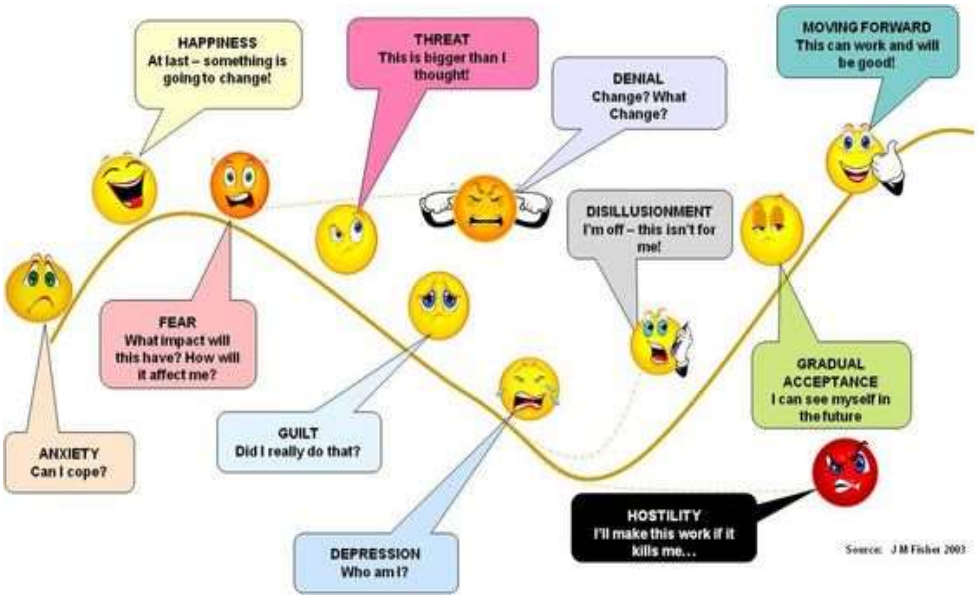

Figure 4 *Employees phycology during a transition process (Darren, 2009)*

Understanding and addressing the causes of these feelings is critical so that all participants follow the course of change. This chapter presents the main reasons why most employees resist upcoming change in the workplace and is given the basic description of how organizations should handle a technological change, in this case the transition to DBMS, in order to make the transition process smoother.

3.1 Why employees resist to changes in the workplace

When a change take place in the work environment, most of the employees who are affected, do not accept it, and try to stop the implementation. The fear of the unknown and the unexpected creates insecurity, even if it will lead to better performance.

Many reasons are responsible for this resistance, as Brusati (2017), who refers to Galpin (1996) 'The Resistance Pyramid', which summarizes the main reasons in three categories, as shown in figure 5, is not willing, not able, and not knowing.

Figure 5 *The resistance pyramid by* Brusati (2017)

Understanding employees' emotions during a new technological change is the first step to manage human psychology. Based on the studies by Brusati (2017), Adenle (2014), Madsen (2014) and Sinha (2014), the following factors have been found to be responsible for employees' resistance:

- **Not willing**

Loss of job: Changes in an organization can, from an employee perspective, be seen as a threat to their position. Any new technological updating, generates insecurity to staff and managers. New smartest advanced systems, such as DBMS, may, can make the work process more efficient, more productive, timely and less expensive, so as a result, limit their work or even worse will replace them. Moreover, lack of knowledge about the new technology, creates uncertainty if they will continue to be productive.

Good notes: Happy employees, who enjoy and appreciate their job, are open and positive to change, seeing the benefits from it, both for the company and for themselves. On the other hand, for unhappy employees, change is one more 'annoying idea' of the company.

Shock for the unknown and unpredictable: Poor planning by the organization, poor preparation and incomplete understanding of new requirements, increase job insecurity, making resistance more robust.

Former change experience: If the organization in the past fails to implement a change, employees are more suspicious of something new. In addition, personal experiences of change play an important role in the intensity of resistance.

- **Not able**

Loss of control: The sense of losing control in their work creates feelings of confusion and loss of dynamism. When the freedom to express their opinion of how they see the change is given to employees, this creates a kind of sense of contribution, aiding at the same time in the system's improvement. This gives employees a sense of control during a transition period, thereby reducing the volume of resistance.

Lack of competence: Moving to DBMS requires new knowledge and skills. The phobia of being unable to respond to the new demands increases resistance. They already know how to work and by starting something new will cost time, effort and personal growth. In addition, many people's reluctance to learn new ways of working, especially if they think it is right and do not need corrective moves, is a problem.

Lack of motivation: Provide additional incentives to workers who support change throughout the transition process. It does not have to be expensive or huge. Only to increase the motivation of people, showing that if they try for it they will have personal gain.

Loss of support system: Trust in long-term colleagues, security of routine and trust in the support system is the comfort zone for employees. New environment, new people and new systems are unknown to them.

- **Not knowing**

Bad communication strategy: The way it will be chosen to show employees how the system will be implemented, organizations and individuals benefits, is critical. If an organization fails to convince its employees of the need for the upcoming change, especially those who have been working there for many years and firmly believe in the current way of working, resistance will be incredibly great.

Poor timing: When, how and why the transition will start are very important aspects. When a company decides to make a significant change, it must take into account the important initiatives in progress. If a change is entered in an unconscious way or in an inopportune time, then the resistance will be greater.

Leaders and managers lack abilities: If an organization’s managers are unable to communicate properly and do not know how to approach employees when a change occurs, things will appear more confusion. Leaders and management do not give the appropriate understanding to human

psychology and that is an issue in many organizations. Moreover, conflicts and disagreements are a part of almost all organizations. Bad relationships between people, increase the possibility of resistance in a change, especially if they have conflict with people who are bringing or leading that change.

Sympathy and comfort: When new goals and interests are coming out, reinforcement is required. Personal sympathies, people who trust each other and have learned to work together, are resistant to any change that affects their cooperation.

Lack of trust and support: Organizations that show that they trust and support employees, are in a better position to present a change. On the other hand, when behaviour towards them is not as good and they feel that any mistake can cost them their job, employees then will assuredly resist the proposed change.

Figure 6 *The main reasons of employee's resistance*

Figure 6 summarises all the above reasons of the resistance to change. The majority of them is a result of people's values and beliefs, sense of identity and personal purpose not being met. People do not leave their emotions, doubt, fear or lack of trust at home.

3.2 Change management

Before analysing how organizations must deal with employees' resistance, it is good to name the main difference between change and transition. Change is the shift and transition is the process of one state of being to another. As Bracken (2014) mentioned, a lot of attention is focused on what to manage, such as goals, strategies, action plans or project plans. What is often ignored or downplayed is how to lead people through transition. Change is the external

situation, transition on the other hand, is the internal process that people must go through to adapt to the change, and the new situation it presents. Until people successfully transition from the old way to the new way, the change will not happen. That process is called change management (CM).

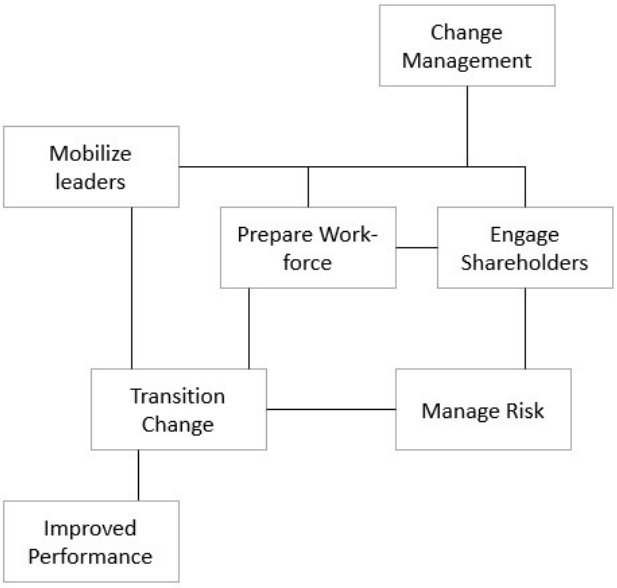

***Figure** 7 Change management's focus aspects and their connections (Adenle, 2014)*

CM focuses on the activities required to help transition business people impacted by the change from their current state to a new way of working (Darren, 2009). As figure 7 depicts, CM is helping to manage shareholders and stakeholders (leaders, managers and workers) during the transition program.

3.3 How to deal with resistance to change

The effective approach of how an organization should handle their employees during a transition process is mandatory. Companies must understand the reasons for the resistance and be appropriately prepared as to how a change would be presented and enter in the employee's life. CM is an important process, and it must be carried out properly and not underestimated as the company's flexibility is at risk. Combination of performance-improvement methodologies, can be chaotic and difficult to make manageable, but in a long-term change, as the transition to DBMS is, it can lead to better and sustainable results.

As already mentioned the three main reasons for employee's resistance are: not willing, not able and not knowing. Each of them can be addressed by performance management, training

and communication respectively(Dcosta, 2013). The change management process as figure 8 shows, should contain that three elements, including the reinforcement systems.

Figure 8 *Change management process*

3.3.1 Performance management (PM)

A good definition of performance management (PM) is provided by the commitment of foundation of Canada (2017). 'Performance management is a process by which managers and employees work together to plan, monitor and review an employee's work objectives and overall contribution to the organization'. Creating a performance management cycle, means developing the structure that will follow in assessing employees' performance, emphasising people's needs and practices, which will help the process of understanding and adopting the new system.

Performance management cycle, as figure 9 shows, consists of four main stages. Framing of change, track progress, receive feedback, and analyse feedback. The cycle is repeating till the end of the transition process, ensuring that process stays away from surprises as a result of the ongoing revisions/adjustments.

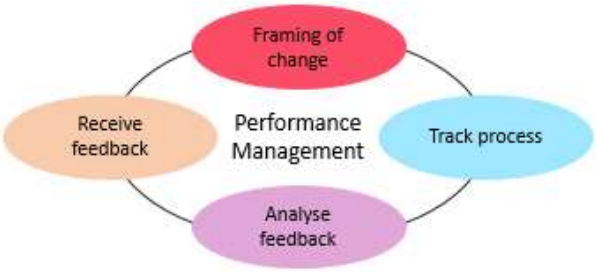

Figure 9 *Performance management four stages*

Stage 1: Framing of change

Lawson and Price (2003) mentioned, the importance of Leon Festinger's theory of cognitive dissonance, which refers to the distressing mental state that arises when people find that their beliefs are inconsistent with their actions.

From an organization's possible change perspective, employees who believe in the need for that change and the way it will come, will be open to change their personal attitude and behaviour to assist change to occur. If they do not believe in the necessity of change and its implementation process, cognitive dissonance will dominate them.

It is not sufficient to inform and train employees about the new working way. Ensuring that all people are involved and are part of the change process, generates enthusiasm and positive expectations. Understanding the individual and in terms of the importance to the overall purpose, increases their confidence in the value of the whole venture. Explaining to and persuading people about the 'vision' of change will emphasise its momentousness for the organization and the individual (economic and rational benefits (Lawson & Price, 2003)). What the new technology is and how it is going to help and what is their part in this. People in significant positions must create and share their 'vision' of the change thereby helping the whole process, but also their self-understanding about it being worthwhile for them.

This approach applied in practice can be divided into the four following steps:

- 1st step: Developing the framing

Firstly, the frame steps that the CEO wants to follow about how the work responsibilities will desisted to share. Figure 10 shows an example of a double-loop learning which will be created using a dialogue-based planning system.

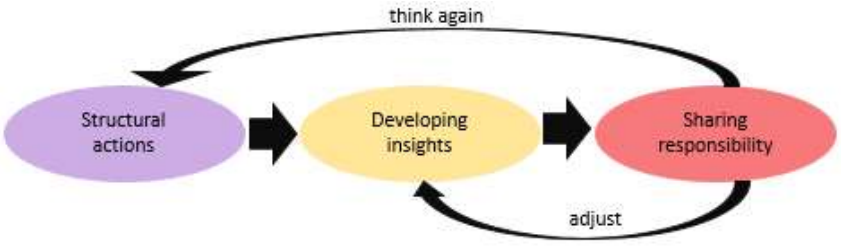

Figure 10 *Double-loop learning*

- 2nd step: Structural actions

DMS replying plan from DBMS includes all transition work process which must take place (see chapter 8).

- 3rd step: Developing insights

Shared vision: CEO with executive directors' (managers) contribution should create the story of the vision. Developing a top-down frame of the way he/she perceived the current organization's situation, the transition period process and the after change in the organization's life. *Emphasis: make sense to all people involved (top to bottom).* Example how that frame can be illustrated in figure 11.

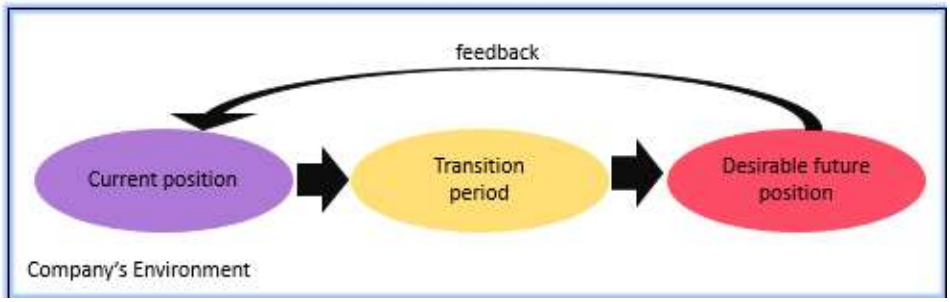

Figure 11 *Approach loop example*

Mental models: Executive directors in turn must create the relevant part of the frame for his/her department, using again the approach loop from the specific department's environment (figure11).

Team learning: Explanation about what the new technology does and how it will help in the organization's work process but also in the department and for individuals. Responsibilities that arose by the mental model design from the department's manager, split to each team's member.

Personal mastery: Individual the members of the team in turn, should develop a strategic plan, using one method that organization will show, such as SWOT analysis and balanced scorecard, how he or she will prefer to approach the new technology.

System thinking: The definition that The Institute for Systemic Leadership (2017) used is 'Systems thinking is a management discipline that concerns an understanding of a system by examining the linkages and interactions between the components that comprise the entirety of that defined system' Executive directors and CEO must meet again to restate their department's relevant parts in order to exchange views, information and feedback.

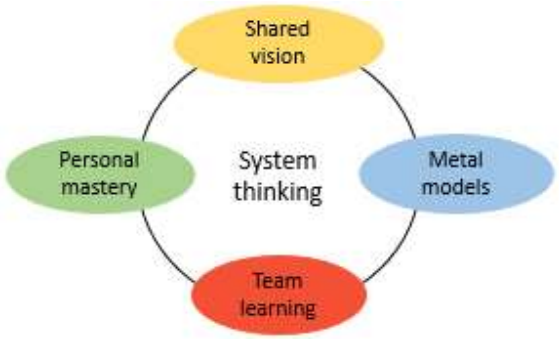

Figure 12 *System thinking steps*

Figure 12 shows that the first four developing insights illustrate the system thinking process.

- 4rd step: Sharing responsibilities

At each level of the organization, an employee must head the relevant version of the proposed changes from his or her immediate boss, the person widely regarded as the most effective communication channel (Lawson & Price, 2003). Ensuring that everyone fully understands what is its own contribution to the change process. *Emphasis: describe the improvements that DBMS will bring in their working life, not only the organization's, shareholders', and clients' benefits.*

Stage 2: Track process

Saying track or monitoring is not the cameras installation or sudden regular checks, in order to punish workers who do not use the new technology. Monitoring is the procedure which aims to identify wrongs, omissions, failures and well done situations by the people involved in the transition. All that may come from employees misunderstood, leadership's wrong approach of coaching or by its changes in the planning process.

Understanding the new skills requirements means providing responsibilities to the workforce according to their current skills, abilities and knowledge. On-boarding DBMS specialist, so as to influence and help others. By taking the appropriate skilful action, which may involve maybe not choosing the best in technology but most certainly involve choosing the best people, those who have the communication and networking abilities. The sooner those people are part of the organization the better for the DBMS success establish process.

Draw attention to the positive results of the DBMS use. Distribute compliments and rewarding in groups, so as to encourage and motivate others to do the same. Rewarding the behaviour you want to see is much more effective than penalizing the behaviour you do not want to see

Emphasis: which employees are adopting the technology and which kind of rewards means the most to them (Knight, 2015). If you are still having a hard time getting your team on board, consider instituting penalties for non-use.

As soon as possible, new technology must be the first opinion for employees. Make it part of the routine. Be the first who will transition to the DBMS, showing that it is the future of organization and they must follow. Do not forget that employees are still learning how to use the new system and if the organization's behaviour towards them is heavy-handed, they will create resistance to the new technology.

By developing a talent management model the tracing process can be effective and efficient. Talent management process (TMP) is the procedure to manage the ability, competency, and power of employees within an organization. Everything that is done to recruit, develop, retain, reward and make employees perform better is a part of talent management (Keka, 2016).

TMP cycle as figure 13 illustrates, is divided into four phases. Analysis of DBMS skills required, competencies assessment, training and development and monitoring and retention.

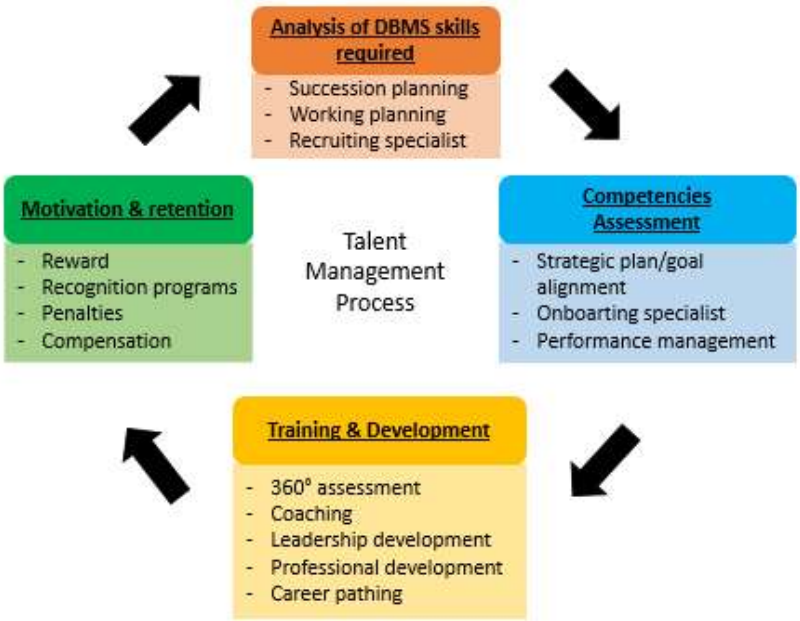

Figure 13 *Talent management process* (Askarka, 2015; DeepTalent, 2016)

Stage 3: Analyse feedback

Feedback improves PM. Wrong feedback analysis can be catastrophic for the organization and for the DBMS. Out of schedule, overrun cost, confusing and mistakes, dissatisfaction and anger in the ranks of workers are some of the results. By improving the feedback system process this

ensures the successful implementation of the DBMS. Figure 14 shows the steps that ongoing performance feedback system should follow.

Figure 14 *Feedback framework*

For a successful feedback analysis, a specific list of standards to be followed by feedback analysts should be created before the implementation process is initiated. Moreover, people work differently; appropriate methods of measuring results to ensure that all workers are judged in a fair way must be implemented. Emphasis on individual achievement is necessary to correct poor performance as well as to enhance the desired or improved results, (Simmerman, 2011). Feedback needs to be clear, understandable and adequate, if people do not understand the concept of information is ineffective and useless.

Stage 4: Receive feedback

Efficiency, tangible and valid feedback are important elements of a powerful performance management system, only if feedback is simulated by setting performance targets. When employees know their progress in a timely manner, it helps them to improve their performance. However, feedback is not only for the employees, all the people involved in the transition phase should be in the feedback program, as are the leaders, supervisors, outsourcers and various groups.

U.S. Office of Personnel Management (2017) has pointed out three components which concern effective feedback. These are:

Specificity: Better feedback when referring to a particular target. Establishing specific realistic performance expectations and objectives for individuals, teams and systems before the transition period begins, is the way to effective and efficient feedback usage. All people involved should know in time how they are doing, what is working, what is not and to what extent, what is asking to improve and what is going ok.

Timeliness: All stakeholders need to have the picture of their progress as soon as possible. By quickly updating the corrections required for their performance, the faster they will be. In addition, positive feedback is important in order to increase confidence and stimulate continuation.

Manner: Feedback should be presented to the people in a manner which will aid improving their performance. It must be exact, real, and complete. However, choosing a positive way to reveal feedback to people, is more effective.

An appropriate approach to feedback is critical to a performance management system. It will be the component that will help people achieve their expectations and goals during the transition phase.

3.3.2 Skills required and training

Transitioning to a completely electronic environment can be daunting for employees and not only. Converting to a DBMS, does not need to be a dreaded process. Understanding the skills needed for DBMS implementation, in a combination with the proper training for all who are affected by the change, is the key for successful adaptation to the new digital conditions. Planning the training program according to individual knowledge and needs, increase leadership coaching and decision-making abilities, and more importantly, give them time to accept, to understand and to digest the new way of working. Training is a continual procedure during a transition period. As EHR survey has shown, it helps to avoid mistakes, errors, delays and other unwanted events throughout the implementation phase.

An effective and successful DBMS training, which will properly assist employees and make them feel comfortable with the new system, should include the following:

1. **Determine end users' digital abilities and offer basic training.**

This is necessary for departments or work positions, which are to a great extent paper-based, and may not be important for those already using practice management software. Employees must be able to perform complex tasks on a computer.

Using one of the computer skills exams that provided online, like the free basic test from Independence University (2015), as well as paid tools like Total TekAssess (Teknimedia, 2017) each end user's computer level can be identified. If the skills needed for DBMS implementation process are understandable, using resources available online, such as ProProfs Quiz Maker

(ProProfs, 2017), each organization can create its own evaluative test according to the computer skills needed.

After that, it is necessary to educate the employees with low computer skills. Providing bridging courses to those people eliminates the fear of losing their job. Private or group lessons through computer tutorials, hiring computer teachers to teach employees inside of the organization and online computer lessons are some of the ways to increase staff's computer skills.

Ensuring that all end users have the appropriate computer skill levels, the transition DBMS period will pass more smoothly.

2. **Specified and familiarity training**

Specified training means, each department or employees should be taught only in the area that is most useful to them. Time should not be wasted in training people in areas that they will not use. Doing that, valuable time is lost, confusion results and this reduces the integration time of the DBMS to the organization.

Additionally, each person has his or her own way of learning, he/she should have the choice of teaching options where this is feasible. Make them feel comfortable by asking each user what type of teaching they are most interested in. Training must be as close as possible to the real situations which employees will have to handle and the appropriate required time, in order to become accustomed to the DBMS more easily.

3. **Fully trained users**

That users must be fully trained about the DBMS use, in this way understanding all functions of the system. Are the inside company professionals trained, who will be responsible to help and answer questions about problems to other users as well as training new members how to use the system?

As defined by Guerrero (2013), these users must meet specific requirements, including high computer skills, fast learning ability, excited about DBMS, transmissibility, leadership skills, well-respected between colleagues, and working in the organization more than a year.

Alternative to training existing employees, is to hire ready DBMS professionals, with ability to influence and teach others. In that case, that person has the disadvantage of not fully understanding the organization's work process.

In addition, not only full knowledge users should answer questions. Increase employees' mutual help. Helping each other is a way to assimilate information better, and join with employees in the new organization's venture.

4. **Feedback during the training**

It is useful to receive and analyse feedback about the change process from all departments. This will provide useful information especially to identify areas that may need improvement As a result, it may be required to initiate a strategic training program. This will also allow the organisation to solve problems that have appeared by order of importance. Regular face to face meetings, interactive intranet website or internal social media tool where they could ask questions to a specialist in real time. Create a redressal mechanism as figure 15 shows for analysis of feedback.

Figure 15 *Redressal mechanism (Dawn, 2015)*

Michael C. Mankins, a partner in Bain & Company's San Francisco office and the leader of the firm's organization practice in the Americas, mentions in the Knight article (2015), 'Encourage your team to do trials, get feedback from users, and learn from that before you take the jump'.

5. **Vendor's guide**

Training and learning online guides, provided by the DBMS vendor. That can be manual help, like step-by-step directions, pictures of various tasks of DBMS or provide pre-recorded videos and seminar. Creation of gamification system including DBMS functions wherever possible. Community forum where join DBMS holders, given the ability to exchange questions about DBMS training and usage. Sharing advices and finding solutions in common problems.

6. **Leadership's mandatory skills**

Adapting how to handle DBMS is not the only training that it is needed. Leadership also need new skills about how to manage and help employees in the whole process. Replacing practices and culture by managers, ensuring the change program success. Skill-development centre where leadership abilities will increase is an option.

7. Emotional intelligence training

Developing new skills is not an easy process. Even the more intelligent employees can falter or be unable to drive teams and inspire people during a transition. Not because they are not clever enough or due to the absence of technical skills. What is missing from them is a high degree of emotional intelligence (EI). What is that? 'The capability of individuals to recognize their own, and other people's emotions (Wikipedia, 2017a)'.

Leaderships, managers but and individual employees, should be going in EI programs, where they will learn the basic principles and brain science of EI. Through these programs, they will learn to control their emotions under pressure, to develop their individual leadership using their emotional brain in critical situations. During an implementation time, the abilities from people in critical positions to influence, engage and associate with others will increase the productivity, reduce transition process's time, and will make the process of change smoother.

8. Adult-learning cycle

The better way to handle a DBMS training is to follow the four abilities of the adult-learning cycle. The figure 16 shows the four abilities which are concrete experiences (awakening), reflective observation (observing), abstract conceptualization (practicing), and active experimentation (applying). Learner (end user) and instructor (DBSM professional-vendor) have their own role in that cycle.

Figure 16 *Adults-learning cycle* (Keillor & Keillor, 2014)

Following the above eight tips, for DBMS training approach many of the ordinary errors and headaches will be reduced, ensuring at the same time the implementation process and increasing employees' learning speed.

3.3.3 Communication

Communication is an integral piece of any change program. Effective communication helps to overcome practical and emotional barriers, join all interested, affected teams and individuals. A strong communication plan should be developed and distributed to people. The model that would be followed would allow all to share in necessary information and thereby bring to fruition the change in the employees. The reasons for the existence of a communication plan includes that it offers timely information to all effect, transfers the vision, suppresses resistance, anticipates and dissolves rumours and gossip, calms and offers the monitoring of employees, and finally is a support key for the change.

Identify influencer evangelists

The identification of influencer evangelists is to discover the role models in an organization. Role models are not only top level employees, but are people who influence and inspired others. In their paper Lawson and Price (2003) explain that within a single organization, people in different functions or levels choose different role models. People from all levels, not only from the top, must be in the battlefield of the change process. Responsible for this, are the role models from each level. Each influencer evangelist is acting with a different way, however, the information should be consistent with fundamental values from the communication plan. That people must have a leader position in the implementation time.

Convince influencer evangelists

Dialogue-based planning to obtain the commitment, the perception and understanding for DBMS needs, from the influencer evangelists at each level of the organization, ensuring that all are moving in the same path. Create passion and mood for the change. Convince them how change will effect positive organization but also convince employees, even if the implementation process would take a long time and need hard work to be achieved.

Communication plan

As soon as is possible a communication plan should be developed, so as to avoid rumours and the dissemination of inaccurate information that would create panic and resistance. It is never too late to begin the implementation process. You carry it out now, so it begins to take effect. The application of the plan starts with the official announcement of the change to all involved. Moreover, there would be transparency and the provision of accurate information regarding the change process and the desired result. The latest outcomes and the testimonials from influencer

evangelists would also be publicised. The plan must be a flexible one that would be able to manage unexpected events and situations.

Figure 17 illustrates the communication plan cycle from 'The Art of Positive Change' during a communication plan development, as published by Anderson (2015) It must consist of the following steps namely, change assessment, identify all people involved in the change, the reasons (objectives) of the plan, selection of the communication technology channels, the schedule for communication, receive and analyses feedback.

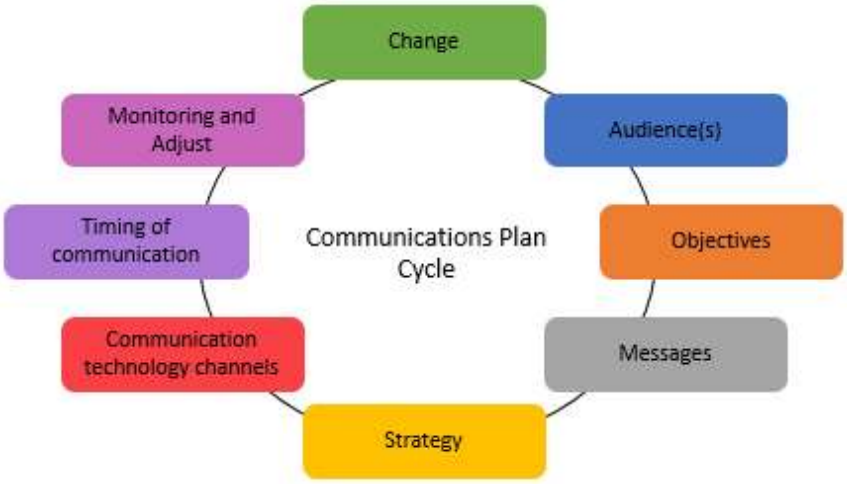

Figure 17 *Communication plan cycle (Anderson, 2015)*

Explain what that change is, how it affects the individuals and as to how the team works, make it fun, gain trust and loyalty. If employees do not feel the necessity of change and that they have voiced this position, even the best technology then is useless. And do not forget they are the users and only through their feedback can you solve the upcoming problems.

3.3.4 Reinforcement systems

Performance management system, training process, and communication approach are not stable situations. After the first approach of how the transition period will be, actions need to be reinforced. When a company's goals for new behaviour are not reinforced, employees are less likely to adopt it consistently. Lawson and Price (2003) makes mention of Skinner's theories of conditioning and positive reinforcement that were taken up by psychologists interested in what motivates people in organizations. Structures and processes that initially reinforce or condition the new behaviour do not guarantee that it will endure. They need to be supported by changes that complement the other three conditions for changing management.

Ensuring that the people with the right skills to change its practices and culture are occupying the right positions. Spending time, money and effort developing managers' abilities and skills, such as coaching and decision making are important factors to the whole process.

Following a method / loop which shows how all individuals' and groups' performance effect an outcome ensuring that all people involved are passionate and fully involved in the whole change process. If not, the appropriate adjustments, reinforcements must be carried out.

3.4 Conclusion of human psychology

The main reasons for workers' resistance to a change in their working environment are the unwillingness to change because of fear of losing what they have created, after the fact that they do not have the knowledges and skills to use the DBMS and ultimately because they do not know the details of the transition. In order to achieve successful DBMS, it is important to effectively apply CM system during the transition process. Management of all people involved in the change is essential. Earn their trust and persuade them about the importance of the change by making them part of the transition. Transform resistance into a positive contribution by making the correct movements. Addressing the resistance to change by developing an effective PM system, so as to defeat any reluctance exhibited. Define the new skills requirement, and schedule the training program that will give the abilities that are needed for the new system. Next comes the creation of an effective communication plan, wherein with the aid of influencer evangelists, will inform and be informed about the transition process. And finally, the last step in the CM cycle is that of the reinforcement method to aid organization to make the necessary adjustment to the CM's other phases.

Chapter 4 Challenges with Today's Requirements

With the use of DBMS issues arise out of the way it is managed and performed by an organization, but also nowadays from industry's digital ongoing requirements. Over the last decade, more and more organizations are turning to DBMS to increase opportunities and gain more visibility in their business. That has been an asset to the database management industry but it has also created major challenges for DBMSs. This chapter outlines the key challenges / requirements of today's use of DBMS and the actions required to resolve them by DBMS professionals and includes both, application programmers and database administrators (DBA), from both, organizations and DBMS vendors.

4.1 Key challenges facing DBMSs

Data is a vital element for an organization. The speed, volume and variety of these data are constantly increasing, resulting in the challenge in terms of execution, coverage, know-how and cost of managing the database. DBMS professionals have to address critical issues to meet current industry requirements. The main challenges that need to be addressed are:

Multiple database platforms and data structure

Multiple database technologies are being created and are increasing exponentially, due to the growing of volume, size (big data) and variety of data types. Dealing with the structured but also with the unstructured data is essential. As per Fricke (2015) referring to Nadkarni and DuBois (2014), unstructured data are going to be more than the structured in some years. Immediate and effective treatment of this issue is a prerequisite. DBMS professionals should learn to manage complex, unfamiliar database platforms in an effective and efficient manner to cover organization's requirements.

Application-centric approach

The variety of data today is rising due to all new applications that make up the internet of things (IoT), such as smartphones and tablets. Organizations must adapt accordingly to new requirements. The variety of sources and types of data, has made for an increasingly database centric mixture of data management technologies, turning them into a more specialized extension, and making data management more diverse, more application focused. Database professionals are responsible not only for the efficient rendering of the database but also for application performance, because at the end of the day, this is what matters to the organizations and to end-users.

Transition in the cloud

Organizations today require cost savings, additional flexibility and more agility. As a result, many organizations are watching cloud as a different option for developing new applications including those with high database performance requirements. As Fricke (2015) explained, cloud computing allows users to attain optimized scaling, high availability, multi-tenancy, and effective resource allocation. Nevertheless, this shift develops intense pressure and responsibilities for DBMS professionals, as they now have to handle both database performance and data security, independently of whether the data is running on-premises or in the cloud.

Data security

Organization data, particularly sensitive data, must remain safe from threats and risks, violations and breaches by internal and external factors. Organizations require DBMS vendors to be secure and trustworthy. They demand a safe place for their data and accuracy on what is happening in their businesses. Business success is closely linked to data security and the responsibility of DBMS vendors is to ensure that this security is untouched.

4.2 Solutions to the challenges facing DBMSs

The adoption of a managed service approach to reinforce the DBMS, which will allow organizations not only to meet these challenges but also to prevent them in time, is necessary. To overcome these challenges and have an effective and efficient DBMS, the following are needed:

Multiple database platforms and data structure

The efficient way to manage big data is foremost to structure them in a meaningful way. In this way the appropriate technologies should be chosen that would help you gain the value of the data. Even with the choice of the latest and advanced technologies, recording and storage data is the basis for the infrastructure of most organizations. DBMS professionals should ensure that data is actively sorted, that system metadata are automatically added, and that user metadata are added at the time of creation (Fricke, 2015), by create a type of structure in unstructured data. This can be done by understanding unstructured data types, and then consolidate the data taking away redundancy to the fullest extent possible.

To manage effective multiple database platforms according to Dada (2016), what is needed is to employ a set of goals, metrics and SLAs across all databases, preferable according to the

application response times. Use tools that provide a single dashboard of performance and analysis capability in database technologies and methods development, containing cloud. Set up a strategy, a road map and cloud transition guidelines (or not), and decrease workload costs by moving databases to lower license versions or open source alternatives. Ensuring that the DBMS professionals team, are fully involved in the database performance, maintenance and innovation, knowing how to escape and capture threats. It would be helpful as a matter of record to maintain a complete set of processes to ensure integrity and security.

Application-centric approach

Be proactive by constantly checking the performance of applications and the consequences on the database, taking advantage of the daily experience of users. Measure performance of applications by the end-users' wait times so as to have a picture about what both end-users and database are waiting for, offering bright viewability into bottlenecks. Apply tracking tools which offer viewability across the entire range of applications, including all database support infrastructures, like database servers, networks, virtualisation layers and hosts. Identify discrepancies by checking the historical baselines of application and database performance that examine how applications run simultaneously.

Using a single common interface which gives access to remote and dissimilar data stores, makes it easier to destroy silos in database management. Employing open-source solutions permits will offer high performance, agile and expandable technology at low cost.

Transition in the cloud

Cloud gives many opportunities that on-premises do not, the appropriate attention must be given even if it is seems that the silos problems are being solved. DBMS vendors are responsible for properly guiding an organization to explore scenarios that show the right cloud transition, and to discover the appropriate resources that match their requirements, either by referring to the organization's own data centre or from external cloud sources or software providers.

What DBMS vendors should consider when an organization wishes to shift to a cloud are:

- The process of data transfer and the delay and how to keep synchronized databases if needed;

- Shifting to the cloud due to a bad on-premise database performance does not make the situation better, on the contrary, it just makes the process more expensive;
- Schedule the shifting process by backing up and recovering so you do not lose important data in case of failure or interruption;
- Who will be responsible for database security? Be prepared for the worst and have a documented course of action if there is a violation, a breach or missing data;
- DevOPS practices can be integrated, in order to have an ongoing integration, test and development allows one to raise application velocity and reduce time in value;

Data security

Organizations base their data security on DBMS, and DBMS professionals are in turn responsible for achieving this goal with effective security controls. Proactive rather than reactive is the right way to manage a data breach. In cooperation with other departments, database security experts should follow the semi-normal security assessment of the physical configuration of the system first and then the environment surrounding it.

4.3 Conclusion of the challenges in relation to today's requirements

Today's requirements demand from the DBMS vendors to switch to a multi-application database platform, manage both cloud and on-premises, while increasing database security considerations, increasing the workload required for DBMS operation, making work for DBMS professionals intensive and demanding. By following the best practices and being well prepared, these challenge can be overcome gaining the best use of the DBMS.

Chapter 5 Work Processes

Developing a DBMS according to the basic data processing principles is mandatory so as to utilize all benefits and ensure the work process. Data, and more specifically the original raw data, should be stored safely, but be easily accessible for analysis (Clay et al., 1998). DBMS must be integrated with the data collection system to the greatest extent. The approach to database design and software development is different when building a new system than to adapting an existing one. However, both should be well documented. In order to gain all the benefits that the system offers, the system must direct the end user providing facilities such as help and local language selection. It should possess flexibility and provide easy manageable data processing, where important functions and controls must be integrated. It is also necessary to maintain a regular operations and maintenance schedule, and with a systematic re-evaluation and upgrade to the design, ensure that the system is achieving its goals. Control and security of access and data distribution, guarantees the integrity and confidentiality of data in the database. All of the above can be summarized in figure 18, in four factors, principles, database design, operation and maintenance, access and distribution. It is the third challenge, ensuring the DBMS process, which will be discussed in more detail in this chapter.

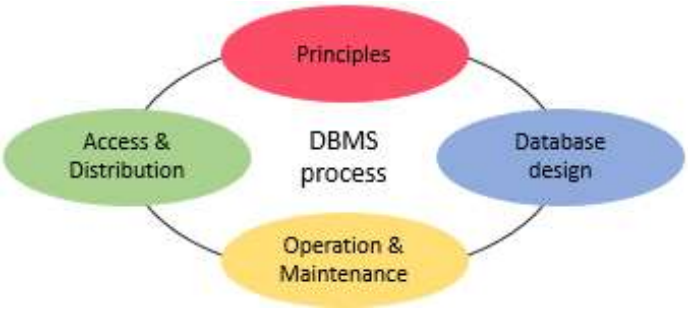

Figure 18 *DBM process*

5.1 Basic data processing principles

The first thing that all involved in the DBMS procedure have to do, is to believe in the DBMS need. This can be achieved by understanding the functions being performed. An organization has to face a large volume of raw data, work process including decision making, policy-making, planning and management, depend a lot on processed information, not raw data. Data must be construed before it can be used and transformed into information.

As has been expressed by Carlos and Rob (2009), and Kennedy (2016), DBMS helps to ensure integrity and consistency of data in the database. Most of those functions are transparent to the end user. The main functions of a DBMS are: data dictionary management, data storage

management, data transformation and presentation, security management, multiuser access control, backup and recovery management, data integrity management, database access languages and application programming interfaces, database communication interfaces, and transaction management.

5.2 Designing DBMS

Database design in an organization is the most critical aspect in order for a DBMS to be able to provide its benefits. With the rapid pace and variety by which information technology is developing, it is essential to look for the most up-to-date advice when a system is selected or developing.

5.2.1 Approach

Effective cooperation between the DBMS vendors and the company is essential not only in the implementation phase but also throughout the entire transition period. The DBMS vendor should be informed and analyses made of all database options and together approach the best database option for the organization. It is essential to focus on the organization's end users difficulties, by answering the question 'What are the benefits for the end users?'

Software options

The options which exist for developing a new database, can be divided into the categories below:

1. Commercial software: Rely on the data quantity and resources availability. For large scale sampling they can be only used for initiating data collection programs and prototyping. That tools must tract in a large sampling and data collection in the end may be appropriate to pass in to a more formal and robust system. Low initial cost but higher cost maintenance demands.

2. Combine different software elements: Piecing existing and new software. Modifications to an existing system can sometimes cripple their intended function.

3. Custom software: Depend on the presence and enduring attendance of the database developers. Future plans to reduce risk of failures so as not to need these developers. High initial cost but lower cost maintenance requirements. As explained by Clay et al. (1998), it can be configured to match closely with the data sampling methodology. It can also be used as a tool to assist in the development of the data collection programme.

Software development life cycle

In designing and developing a database system, following a standard software development life cycle, as figure 19 shows, is mandatory. Otherwise, system failures, additional costs and schedule overruns will occur.

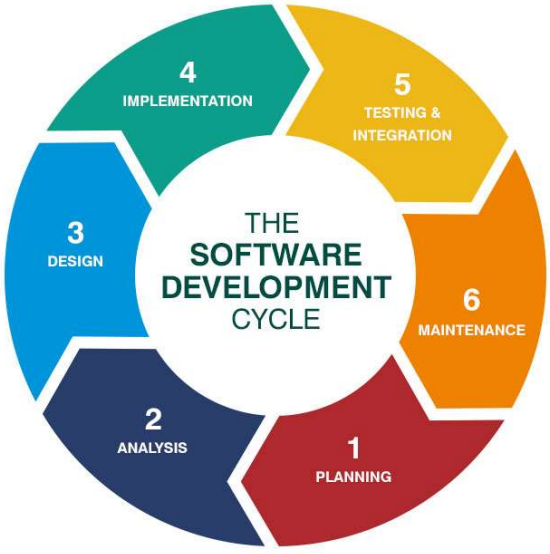

Figure 19 *Software development life cycle (Online, 2016)*

Teamwork job

Database developers, understand and participate not only in the data management system development but also in the sampling system. However, it must be pointed out that they do not know the real needs and operating mode of each industry. And here help is enlisted from each organization's IT experts. An organization's computer professionals may not be involved in a database system implementation, but their contribution to the whole process is enormous. Their knowledge of the company's sampling system make them a critical component in a project's success. The proper cooperation between the two parties can bring benefits to both sides. Software vendors must help the organization in creating internal software evangelists through effective marketing and post-sales training.

5.2.2 Human-Computer Interface

The industry's information systems become a complicated issue to manage due to the large quantity of data required. Techniques, knowledge and engineering principles blend so as to create systems that are monitored in many forms and stored in numerous places.

IT professionals are a critical part of an organization's operation. They link all company's departments and not just with the all-important information. Skills in both informatics and technology are required in order to be maintain data management IT.

Humanizing complex engineering systems to consist of information about human characteristics, like physical and sensory skills so as to obtain safe and healthy productivity, efficiency and effectiveness, quality and economy. That process is called Human Systems Integration (HSI), and as figure 20 depicts, embodies people, workplace and management.

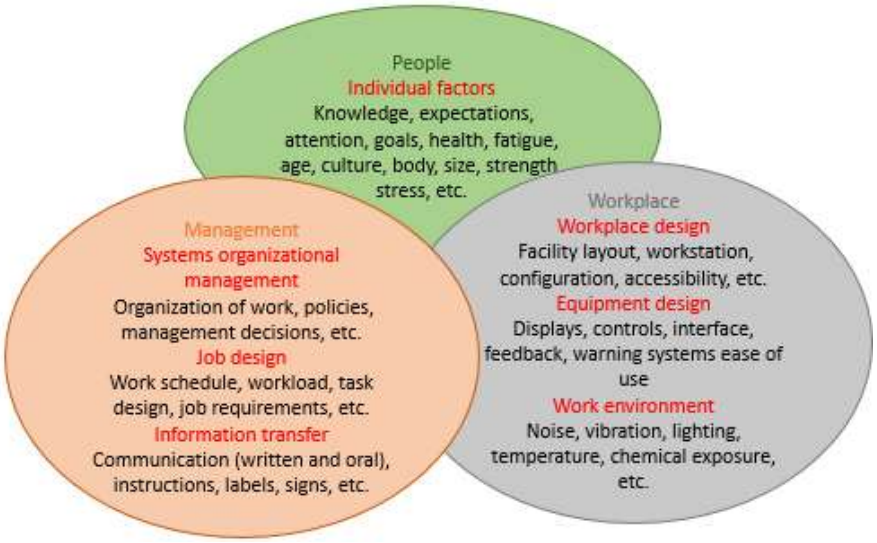

Figure 20 *The integration of human factors (Keywordsuggest, 2017)*

In the case of the DBMS, the system is the computer, so the component appropriate for smooth work processes is the Human Computer Interface (HCI). Data codes, decision-makers, managers and generally all users of a DBMS must be involved during the development of the HCI. Some of the fundamental principles which must be embedded in the system are:

- Automated drivers, showing the correct way that the system works to all end users;
- Describe functions using graphical structures;
- Explanation for all commands throughout the menus;
- Local language facilities. Every effort should be made wherever possible to use the local language. As a result it becomes easier for local users to comprehend, increasing both the quality of the data and the rate of learning for local users;
- Easy accessibility help-buttons, online and offline.

Moreover, online guidance, documentation, seminars, visualization, and training are components that can help in the sustainability of a DBMS.

5.2.3 Data visualization and fusion

Ensuring the work process may be achieved by means of the way data is presented to employees. As described by Crooks (2015), data visualization is the concept of introducing data in a visual frame, such as a graph or a map, to help employees comprehend the importance of this data. In this way employees receive more organised data and as a result it allows for easier and faster processing and comprehension of a great deal of information that cannot be communicated so easily in text form. This is illustrated in the presentation of trends and correlations. Additionally, Fatima, Satpathy, Mahapatra, Dash, and Pradhan (2017) explained that data visualization also helps in the information security field, the transformation from data silos to an integrated approach of data conversion into information. This furthermore assists the total information protection and digital crime investigation objectives.

5.2.4 Business Intelligence (BI)

Business Intelligence (BI) refers to implementing a series of technologies to transform data into important information. BI, as mentioned by Mishra, Hazra, Tarannum, and Kumar (2016), has two different concepts when it comes to intelligence. The human intelligence and intelligent knowledge. The first is the aid which comes from human abilities through management and by making decisions on a variety of problems and the second has to do with help from experts and the application of advance technology.

5.2.5 Data phases

The correct understanding of DBMS features is needed during the design process. Figure 21 present the simple database model, which is constituted by data entry, data processing and data reporting.

Figure 21 *Simple database model*

Data entry

When the transition from DMS to DBMS is taking place, more attention to the data entry system is needed. The projects important point as described by Cushman(2013), is ‘the creation

of a searchable e-dictionary, data entry screens, back-end tables, and bulk-upload tools (for laboratory, imaging and other high-throughput data) are generated directly from the dictionary'.

Necessary action in the development or modification of the data entry system involves the entry of historical data in the system, which has not been saved in a computer source. All potential bulk load data conversion methods/tools such as scanning, workers passing data, must be examined so as to integrate the data in the company's dictionary.

Furthermore, protection of the integrity and quality of data, an 'import' operation that will offer the possibility to integrate data widespread in alternative formats.

The creation of appropriate software links, to assist the retrieval process of data from other computer media is necessary. And in this case, emphasis must be given to data integrity and quality preservation.

Data validation can be applied at several levels, including data entry. Data entry users must follow specific principles/standards in order to enter data in the system.

Data processing

Data processing is the ability of embedding control and processing into the database by following a sequence of steps or functions of processing data, as illustrated in figure 22. In these cases, ensuring that data integrity and validation is maintained. Following those steps to succeed:

- reduce work outside the system
- offering more direct data validation
- gives elasticity for amendments to the system when it will be needed

Critical aspect during the data embedding, is to follow the same audit trail for all data which will be examined.

Flexibility in parameters which can be easily changeable whenever possible in the system's structure and function. During the system's life, alterations and modifications are required. If that is happening without major modulation, sustainability of the data system can be maintained.

After the creation of the data archive/dictionary (all passed from the data processing steps), the steps that raw data of a new project has to pass so as to be integrated into the system as presented

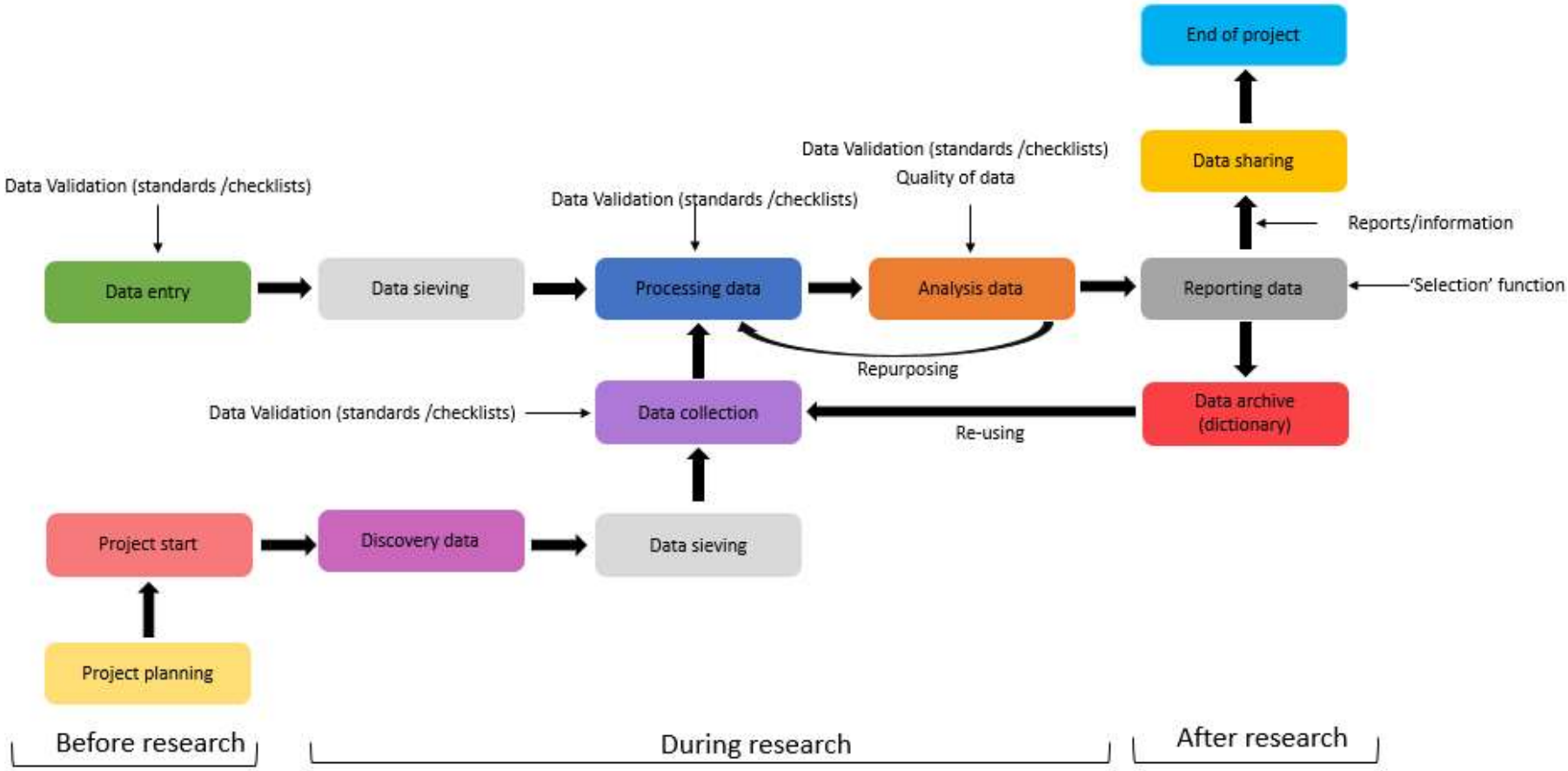

Figure 22 *Data life model based on (Arizona, 2017; Commission, 2017; Essex, 2017; LLP, 2017; Tank, 2017; UniversityAmsterdamVU, 2017)*

in figure 22, includes project planning, project start, discovering data, data sieving (or preparation), data collection, data processing, data analysis, data reporting, data sharing, end of project, data archive (dictionary), and data entry.

Data reporting

Conversion of data into information throughout reports. The feature that is needing for accurate reports is flexibility. The use of the data is not always clear if the system is not operational. Reporting, aids to avoid secondary modifications, making easy the retrieval process of the data.

In order to achieve this, the existence of a 'selection' function which will contain specific characteristics must be entered in all export data when imported into the system, such as:

- Determining name-tags to the data that enter the system
- Selection between specific categories of data

5.2.6 Geographic information system

Geographical information system (GIS), is needed for capture, store, manipulate, analyse, manage, and present spatial or geographic data (Wikipedia, 2017b). And that gives the ability to view data from other geographical locations.

5.3 Operation and maintenance

5.3.1 System support

The long-term support from all involved to the DBMS, is mandatory for maintaining the database. Must be provided by personnel (database experts), who will be responsible for the continuous modification and upgrade of the database, according to the needs which arise. If an organization neglects or fails to give that support to the system, gradually the potential of the system will fade, and at the end can even bring about the system's collapse.

5.3.2 Backup and archive storage

Periodically, the database must be backed-up. Hardware and software failures are in the schedule, so the database must be always ready. It is important that the database is regularly backed-up and stored. By simplifying the system's functions, this ensures that systematic backups and storage are carried out.

The development of technology is occurring rapidly. Databases must be developed and follow this rapid technological evolution. Effective data archiving (dictionary), is necessary for the recovery of historical data stored in the previous structure or design.

5.3.3 Planning re-evaluation

Receiving ongoing and accurate system's feedback, effective analysis of them ensures that the DBMS is achieving its goals. All DBMS users must be encouraged to give feedback and present positive and negative observations, helping this way in the system's improvement.

Additionally, re-evaluation planning should be included in the system's upgrade, so as to follow all technological innovations. Particular consideration must be paid to developing procedures for upgrading existing data, in this way avoiding loss of the old forms. What does that mean? It means that it is important to ensure the creation of the data catalogue /dictionary including metadata, so that users have easy access to the old data, reducing the searching time and thereby also avoid losing information.

5.4 Access and distribution

5.4.1 Secure and control

Data are a company's value resource. The creator of them, the principle owner (companies, government, etc.), have the right to manage, secure and control access. Specific actions must be enforced to safeguard the data, providing safe, continuous and trouble-free access to only those who must access the data. More details in the next chapter 'Database Management System Risks'.

5.4.2 Information sharing platform

Networking and communication

The key to sharing information nowadays, is the use of communication networks. How the data distribution will take place, must be considered during the designing phase of the DBMS. Developing a database which will facilitate and expedite access to the DBMS worldwide event and remote locations, is essential.

Digital media asset management and sharing platform

Nowadays the power of digital media must be used for information sharing, giving safe access to data and itemized outcomes. As mentioned in Google Cloud platform (2016), the two driving forces for this power is the, variety of mobile devices options, offering users a plurality of facilities, and the trend towards a plethora of social networks to embody media sharing as a key characteristic of their systems.

Creating an organization's social network, by which all shareholders have access to all information/data through fast and easy means. Features from famous social media, must be adopted and inserted, in this way making it familiar to the end users.

5.5 Conclusion of work process

Design database and develop software in such a manner so as provide the storage and access data process, making it flexible, fast and valid. Concentrate on creating web-based tools for quick, exact, and safe data entry, develop an operation and maintenance schedule, and create a secure and controlled information platform for monitoring and receiving data.

Chapter 6 Database Management System Risks

Companies implement DBMSs in order to improve their work processes by benefiting from its data processing, managing, and providing components. However, the transitional period is long, with many hidden dangers, which require a good understanding, management and monitoring. This chapter provides help in identifying and defining implementation of the DBMS' risks and understanding and assessing the effectiveness of existing security controls to mitigate these hazards.

6.1 System implementation risks

The first DBMS risk approach, focuses on the risks arising from the planning, implementation and monitoring of progress. The organization's authorities, project management team, IT department and DBMS vendor's team, unite their capabilities and knowledge to safely approach the system.

Figure 23 *System implementation risk categories*

As shown in figure 23, the three categories that need attention to DBMS implementation risk management are the authority consideration risks, the performance risk and the operating environment risks.

6.1.1 Performance risk

Performance risk refers to the project management team and the way it ensures that the implementation project will work within an effective and efficient framework. This can be achieved by paying attention to the following:

Project management teams abilities: the people who will be responsible for the project should fully understand the DBMS's capabilities and requirements including budget, timelines and problems, having knowledge and skills to build and manage effectively and efficiently the transition phase's needs.

Completeness project planning: Identification and structure of project goals. Planning phase is an important aspect when the DBMS will be implemented. Understanding all requirements

and the project's challenges, developing choices, actions, and alternative solutions to increase opportunities and decrease risks to project goals. A risk mitigation plan should be included.

Implementation project planning: Execution of project planning and managing scope, including budget, deadlines, requirements, organizational and human impacts, under the protection of the risk mitigation actions which have been selected.

Monitoring and reporting project planning: Monitors the selected project implementation plan, including risk avoidance actions. Reporting problems and new risks that have been identified as well as changes and modifications of the original plan. Finally, an evaluating plan and risk process effectiveness throughout the project (MITRE, 2017).

Process measurement: Making frequent measurement process, even if it seems that everything is within the scope of the project. Check all requirements and what level of achievement is found. Applying an on-going measurement system is recommend by Lientz and Rea (2004), if possible, this will provide additional information on the system's progress.

Understanding employees: During the project life cycle, project team with the DBMS expert help, must list what is expected end-users are to do, how they're able to do this, each according to their personal knowledge and skills and how they will teach the new way of doing things. Emphasis: Teamwork makes the dreamwork. It is not just the project management team, the DBMS vendor and IT department that has an obligation to do that; employees must have a voice in all of this, and as Lientz and Rea (2004) in their book, 'If the business wants the system and new process, they have to be willing to put 'skin in the game' or be part of the effort. They cannot just be spectators. They have to be participants'.

Additionally in this factor, as we have already analysed in chapter 3 'Human Psychology', resistance to change has to be addressed and given due consideration, taking all the necessary measures.

Achieve the benefits: Implementing the DBMS will bring many benefits to the way the organization operates, but if these benefits do not translate into tangible results, the system will fail. Figure 24 shows the steps to be taken so that all benefits from the system can be obtained. Emphasis: You measure not just the new process, but also what would happen if the old process were to continue to operate. This has been expressed by Lientz and Rea (2004).

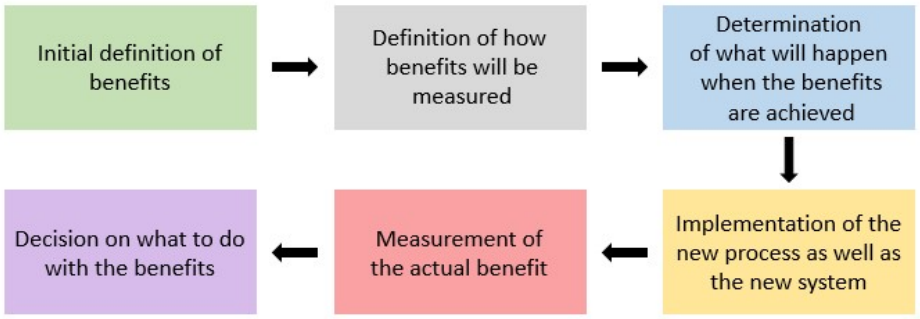

Figure 24 *Benefits attainment (Lientz & Rea, 2004)*

6.1.2 Authority consideration risks

Authority consideration risk, refers to the business rules on how to manage the new implementation process to meet the needs of the organization and to obtain the desired benefits. This can be achieved by paying attention to the following:

*Understanding organization's process goals and related risks***:** Understanding the reasons for the organization to replace the DMS with DBMS. Define the new requirements and determine the scope of the project, so as to identify the related risks.

Authority's rules: Organization rules are the accurate instructions for how to deal with specific tasks or transactions. By understanding these rules, it is the only way for the new system and process to meet the organization's requirements and provide the benefits.

Financial considerations: The Authority must understand that this is a long-term effort and is quite costly. They must be able to spend what is needed during the life of the DBMS. A general cost estimate is required to get an idea of what it takes and where that money is to be invested.

6.1.3 Operating environment risks

Operating environment risk, refers to how the system provides adequate and properly structured support from security controls, such as IT operational controls, data integrity controls, data availability controls, and data confidentiality controls. This can be achieved by paying attention to the following:

System interface: It refers to the transition process (hybrid period) where the two systems, DMS and DBMS will work together. This interconnection system has many problems and hides many dangers. Requirements on how this is to happen (planning) should be considered in a timely schedule, including as mentioned by Lientz and Rea (2004), in the content, timing,

frequency, validation of interface, backup in the event of a problem, recovery if there is a problem and shape.

System integration: It refers to the final integration of the DMS into DBMS. As on the interface, integration requirements should be considered early enough to avoid risks and threats.

Data conversion: Converting data from the DMS to DBMS is a very difficult process that hides threats and risks. Loss of data, data transferred to the new system with different meaning, data with dubious validity and accuracy, poor data quality are names of some conversion problems. Figure 25 illustrates a functional model for how to select the data that will enter the system. It is also necessary to find a solution for the lost / missing data, if no longer needed or needs to be created and added to the new system. The time conversion process must be taken into account, not too early or too late.

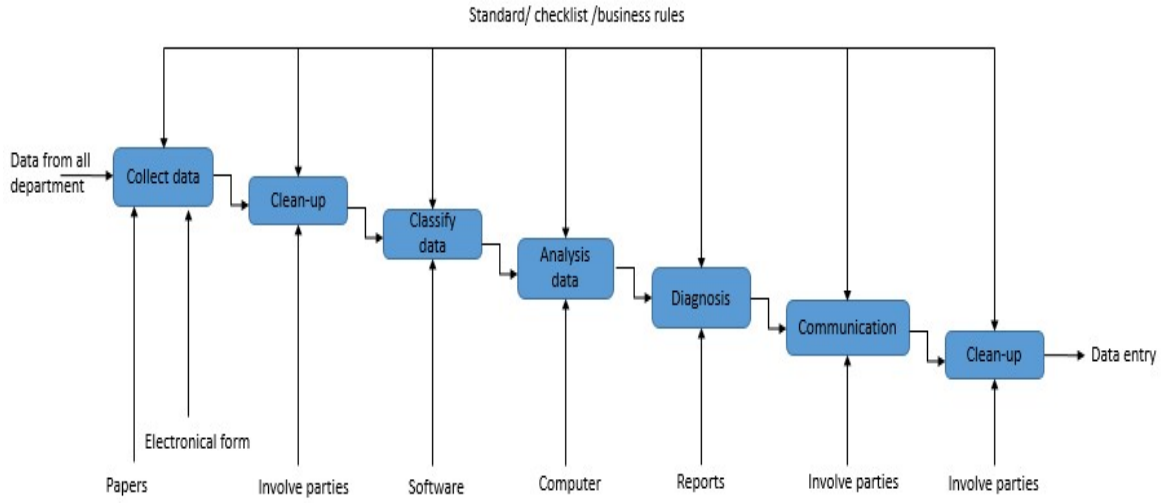

Figure 25 *Data selection steps*

Information security: It covers the organization from internal and external attacks. It protects the integrity and confidentiality of data and ensures the availability of information (Dhingra et al., 2016). If the information security has been wrongly built without all the mandatory security controls, so that it is able to support the operation and the maintenance process, the organization is exposed to a variety of risks. Monitor security controls and evaluate their effectiveness throughout the process, identify new ways of covering new threats.

End user involvement: During the life cycle of the engineering system, the contribution of end-users is essential. They are going to use the system to accept and avoid the dangers. By designing and developing a system according to their needs and close to how they learned to

work, they will provide substantial feedback during the implementation time, contributing to the assessment and reinforcement of control systems.

Seek and use vendor's experience: Vendors are more familiar with the DBMS process. They have the knowledge and experience required to assess the risk. Their contribution and close cooperation throughout the lifetime of the project is mandatory.

6.2 Understanding and assessing existing controls

Designing a secure DBMS, exchanges between operational environment, financial parameters and performance have to be made. Security database, if built with high safety, can be very expensive and very difficult to use. This may prevent the organization from using the system, making it useless.

6.2.1 Information security and its requirements and objectives

As defined by Feikis (1999), data security is mean to protect information from attacks, exposure, modifications or destructive treatment of software or hardware techniques. This is done by following three security areas:

1) *Security policies:* There are instructions that describe what is expected from the information system. There are three types of security policies according to Patil and Meshram (2012):

- Mandatory access control policy, which limits the ability of a user to access or generally perform a function in an area;
- Discretionary access control policy, also known as rules, shows who can access the information according to the user's identity and authorizations;
- Role base access control, was driven by the need to simplify licensing and direct representation of organizations' access control policies. They arrange user's access to information based on the activities that users perform in the system.

2) *Security mechanisms:* Mechanisms that meet the security policy rules. There are three types of security mechanisms according to Feikis (1999):
    - Prevention of improper access, prevents security attacks during operation;
    - Detection of improper access, detects tries of security attacks and successful security attacks when or after they occur;

- Recovery mechanisms, coming after detecting a security attack, returns the system to pre-security attack conditions.

3) *Security system assurance:* Ensures that security mechanisms follow the production requirements, including integrity and consistency.

Emphasis: Main objective of an information security system is to keep information confidential throughout on all transactions in the database.

Basic DBMS security requirements

Database management system must meet three basic security requirements for data protection: *confidentiality*, *integrity* and *availability*. Firstly, confidentiality refers to the ability to access information only from authorized users. Secondly, Integrity divided into two types, physical integrity and logical integrity. Physical integrity refers to protecting and maintaining the integrity of data in physical problems. Logical integrity is to ensure that information is transformed only by authorized users and includes the accuracy and correctness of the data. Finally, availability refers to having access to information and data, always within the acceptable frame.

Objectives on DBMS security mechanisms

The following DBMS security objectives must be covered by the security mechanisms to provide comfortable and safe operation in the organization when using the DBMS. The most important security objectives as Cvrček (1998) mentioned in his paper, are: protect data from unauthorized users, protect confidential information from inference, ensuring database integrity, operational data integrity, semantic data integrity, accountability and controlling, user authentication, managing and protecting important data, multilevel security according to their importance and to isolate themes in order to avoid unnecessary data flow between programs.

6.2.2 Risk identification of security threats

Risks and incidents of database management systems that can lead to risks need to be taken into account. DBMSs are currently facing many different kinds of hazards and threats. An event that could cause a violation or breach for any category is considered a security threat. The most important threats to a database based on the studies by Cvrček (1998), Feikis (1999),Deepika and Soni (2015)and Malik and Patel (2016), have been found as follows:

1. **Accidental threats**: Natural damages such as fire and water disasters, can destroy the DBMS equipment, as a result, integrity is being abused as well as service rejection.

2. **Errors and omissions in hardware and software:** Mistakes during the creation of the DBMS leads to major security problems. In addition, omissions in the security policies, leaving the system unprotected from dangers and threats. Some of the errors and omissions are:

    - *Weak audit trail*: Inability to create strong policy and technology audit, increases threats and hazards due to the system's weaknesses in stopping, deterring, detecting and recovering risks.
    - *Uncovering backup*: Unprotected backup storage, as a results of various attacks in this area. In addition, unsuccessful tracking and control of system operators may compromise sensitive data.
    - *Weak authentication*: Weak identity patterns permit hackers to take the place of legitimate users.
    - *Forgotten sensitive data*: Unprotected sensitive data on forgotten databases is exposed to the risk. Organization's effort to raise awareness and protect the new database and all information about it, lead information that is not part of this database system to risk.

3. **Human errors:** Poor understanding of DBMS users, which can lead to inadvertent violation and breach, is a major threat to the system, as are the following:

    - *Lack of security DBMS experts*: The lack of expertise within the DBMS security organization makes the database system weak, exposing it to attacks because of inappropriate people to manage threats, implement security controls, and impose policies.
    - *Limited training and education*: Not providing the right time to learn the system, inappropriate training courses and teaching in non-specific areas of the system to individuals leads to gross errors and confusion by the users.

4. **Unauthorized access:** Access to information from unauthorised users, attacking of the information privileges.

    - *Level of privilege*: Privilege abuse by excessive privilege abuse, legitimate privileges abuse and unused privilege abuse (Malik & Patel, 2016), increasing the level of risk in data security.

- *Spear phishing emails and malware*: Legitimate database users, inadvertently give access to hackers, who use advanced methods in order to attack the system and have access not just to information but also to sensitive data.
- *Enemy factors*: Major of hostile programs or approaches can harm the system, such as:

  Vulnerabilities: Organizations pay full attention to peripheral security. In this way, data centre is very vulnerable to anyone who can access them.

  DoS attack: Denial-of-service attack, is when a hacker stops legitimate users accessing by removing access to equipment or network resource.

  SQL Injections: SQLi refers to an injection attack wherein an attacker can execute malicious SQL statements that control a web application's database server (Acunetix, 2017). (SQL: Structured Query Language is the most famous database access language)

6.2.3 Solutions for the threats

1. **Accidental threats**

Protect DBMS by providing insurance policies on equipment where feasible, having a powerful and secure back-up system for sensitive data. Developing a B plan is an option if the system collapses.

2. **Errors and omissions in hardware and software**

Weak audit trail: Respond to a weak audit trail by implementing a network-based audit appliances. These appliances must not affect the performance of the database, operate independently of all users, and provide a detailed data collection.

Uncovering backup: Protecting backup copies of sensitive data and tracking users with high privileges is critical to data security.

Weak authentication: Applying passwords or two-factor authentication is required.

Forgotten sensitive data: Manage sensitive data from old databases using encryption techniques and apply the controls and permissions required in this database.

3. **Human errors**

Lack of security DBMS experts: Tackle limited security by hiring people with DBMS experience, improving organization's security culture. Moreover create from existing employees, security DBMS experts.

Limited training and education: Tackle limited training by providing people with appropriate training and increasing security awareness of users

4. **Unauthorized access**

Level of privilege: Unauthorized access is mainly from employees or former employees. By providing significant privileges or not recalling these privileges in time, it makes it very simple for them to carry out their illegal behaviour. However, it is not always advisable as they can do so without it being understood as an illegal action. To troubleshoot abuse of rights (privileges), you must give only the necessary rights to users, no more and providing a good audit trail.

Spear phishing emails and malware: Stop phishing emails and malware by activating firewall protection and installing Antivirus software

5. **Enemy factors**

Vulnerabilities: Troubleshoot incorrect database settings by the creation of accounts with new username and password, not default accounts.

DoS attack: Dealing with denial of service by curing the TCP / IP stack and using an intrusion detection system (IDS).

SQL Injections: Handling of input injections can be done by use of the Stored Procedure instead of direct queries and implementing of MVC architecture (Malik & Patel, 2016).

6.2.4 Security controls

As I have mention above, an organization must plan a security policy which it will show what is expected by the DBMS (security requirements). That security policy includes the security controls that are needed to support the DBMS. As Feikis (1999) reported in his paper, this can be divided into two basic categories:

Operational controls refer to the daily processes and mechanisms used to protect the operating system and applications. It is divided into physical protection which includes physical access control and intrusion detection and protection of the environment, which includes protection from fire, water, humidity, heating and electrical.

Technical controls, refers to the automated security of the system and applications, and it includes hardware and software controls.

Deepika and Soni (2015) and Malik and Patel (2016) present the most important security control methods of a database security:

Access control is mandatory in every DBMS. Protect data from internal and external violence attacks. In addition, ensuring that all systems and objectives associated with database, follow the security policies that have been selected. Controlling access privileges can also reduce threats that can accurately affect database security on primary servers. Access Control systems include file permissions program permissions and data rights.

Inference policy is necessary to protect the data at a certain level. Required when these data are to be analysed at a higher level of security. It also helps to determine how best to release the information. The purpose of inference policy is to stop indirect information exposure. The three ways to exposure unauthorized data are, correlated data, missing data and statistical inference.

User authentication is important to identify who and what data it can access. Define privileges and access permissions to make it easy to control their actions in the data.

Accountability and auditing. Audit refers to the tracking and recording actions of users and no-users into the database. Accounting is the process of maintaining an audit trail for user actions on the system. Accountability and audit tests are required to ensure the physical integrity of data, which needs specific access to the databases and which is carried out by means of checks and record keeping.

Encryption is the process to transform information into a cipher (cipher text) or code (encoded text) in order that only the authorized users be able to read the text.

6.2.5 Improving suggestions for security controls

Data fusion and visualization

The volume of data collected to be analysed is largely due to the variety of uncertain information collected by the threat detection program from different sources, including network threats connected to the database. As reported in their paper, Fatima et al. (2017), data fusion and comprehensive visualization of data distribution lines and rules, illustration/mapping of behavioural and integrated analysis, permit the investigation service to analyse all sorts of anomalies from different data and rules levels.

Integrate native privacy protection mechanisms

Access control model covered the gab with the integration of key privacy retention functions into DBMSs. Although requirements represents a key point for the privacy policies, the privacy awareness of the DBMS can be greatly enhanced by taking into account additional privacy-related aspects. This can be achieved by paying attention to the activities being performed due to problems, violations and illegal data breaches in the database. This has been expressed by Colombo and Ferrari (2016).

Artificial intelligence technology

Artificial intelligence technology covers people's disabilities by addressing and managing actions where a human is deprived. The implementation of artificial intelligence in networking has improved performance and security (Dhingra et al., 2016).

6.3 Conclusion of database management system risks

The risk of implementing a DBMS is divided into two aspects. Firstly, the risk of the implementation process, including the authority consideration risks, performance risk and operating environment risks. Secondly, the security system must be designed to cover the strategy that the organization wishes to develop. Create a security strategy in line with the three key requirements of confidentiality, integrity and availability, and select the mechanisms that fit this strategy with regard to prevention, detection and recovery. Existing security controls need to be strengthened and improved on an ongoing basis.

Chapter 7 Database Management System Resources

DBMS is a subset of an enterprise's information management system (IMS). But what is IMS? IMS is a set of interdependent elements which collects (or retrieves), processes, stores, and distributes information that supports decision-making and control over an organization. These elements can be any of the people, hardware, software, communications networks, and data resources which collect, convert, and spread information in an organization.

The IMS type used for DBMS is the computer-based information system. Hardware, software, the internet and other telecommunications networks, computer-based data resource management technologies, and other forms of information technologies (IT) to convert data resources into a variety of information products for consumers and industry professionals. This has been expressed by Ashwin.S (2009). This chapter presents the five major resources: people, hardware, software, data and network, as shown in figure 26 required for the implementation of the DBMS.

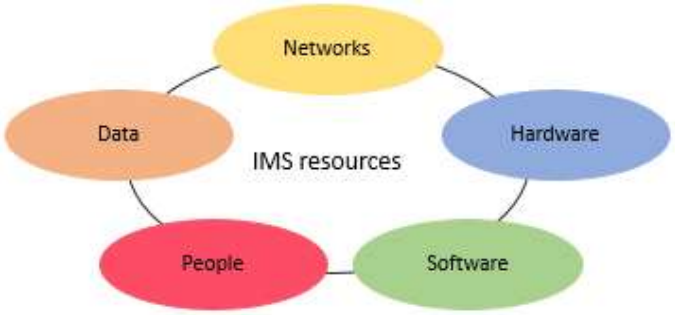

Figure 26 *Information system resources*

7.1 Network resources

Communications media and networks support. For an organization where a computer-based information system is running, telecommunications networks such as the internet, intranets, and extranets are important resources for continual, smooth and profitable operation.

Telecommunication networks are devices such as computers and mobile phones, which are interconnected by communications media and are controlled by communication software. The fundamental resources for all IMS is comprised of:

- Communications media, such as microwave, wireless systems, twisted-pair wire, coaxial and fibre-optic cable.
- Network support, such as manpower, hardware and software.

7.2 Hardware resources

Computer systems and computer peripherals. All physical devices used in information processing are tangible and can be touched. Hardware resources include:

- Computer systems: which consist of central processing units containing microprocessors, and a variety of interconnected peripheral devices.
- Computer peripherals: which are devices such as a keyboard or an electronic mouse for input of data and commands, a video screen or printer for output of information, and magnetic optical disks for storage of data resources.

7.3 Software resources

Programs and procedures. Software, is a series of commands written for a computer in order to perform particular jobs. Software resources comprise a series of information processing instructions.

Programs: a series of instructions which forces a computer to carry out a specific job. One of these is the database access language (DAL) such as is the SQL, a tool used to access the data to and from the database.

Procedures: a series of instructions that employees should perform in order to complete a job.

Data management software: is software that receives data and transforms different types of data into a single storage container or collects various data in a consistent resource such as a database. This term is interchangeable with the wider term data management software, in which many data management resources can direct incoming data to a database or database sets (techopedia, 2017).

7.4 People resources

End users and DBMS professionals. People are needed for all functions of all IMS. People resources include:

- End users: are employees of an organization who use an IMS or information from it. End-users have the proper basic knowledge and skills for an IMS and are work on creating, using and exchanging information.
- DBMS Professionals: are experts who develop and operate the DBMS and consists of system analysers, software developers, system operators and other managerial, technical and DBMS experts' staff (DBA and application programmers).

7.5 Data resources

Data and knowledge based. Data is a valuable resource for a company. How data resources are managed in an organization, is critical in order to transfer all the advantages emanating from them to all the end-users. It is the most important element for a DBMS, and the database contains both, the actual data and the metadata.

- Database: a collection of logically related files of the files. A database consolidates multiple previously saved records into separate files in order that a shared data file group serves multiple applications (Ashwin.S, 2009).
- Knowledge bases: these possess knowledge in many forms like events and rules of inference on many topics.

Note: A lot of confusion between data and information exists, and a distinction illustrating this is the following:

- Data: are raw events or remarks, usually for natural phenomena or organizations' transactions.
- Information: They are processed data that comes to the end user in an easy and useful framework.

7.6 Conclusion about DBMS resources

DBMS is a part of the IMS. when converted to the DBMS this means that the five major resources of the IMS, people, hardware, software, data and network, are affected, and all necessary configurations and modifications must be arranged. Organization must first search the existing DMS resources and then find what is missing and which the best way to obtain it is. The choice of technologies must be based on an assessment of the skills and knowledge of the existing and new employees so as to promote a high degree of familiarity with the new system. The people who are going to carry out the database design and development work should fully understand the skills and requirements of the organization. The network should be structured according to the organization's needs so as to be able to distribute the data to the multiple users.

Chapter 8 Planning and Implementation Procedure

A successful conversion from DMS to DBMS, requires careful coordination of many activities. Many difficult and complex decisions have to be made, ranging from product selection and financial to training and monitoring. The lack of an adequate assessment of the workflow of the organization and the failure to provide proper programming to implement a DBMS, will lead to problems that compromise the success of the DBMS. This chapter includes a way that is based on a *project cycle framework* (PCF) that includes seven phases, from programming to appraisal, as shown in figure 27, on which the planning and implementation procedure should be based so that an organization moves efficiently from DMS to DBMS.

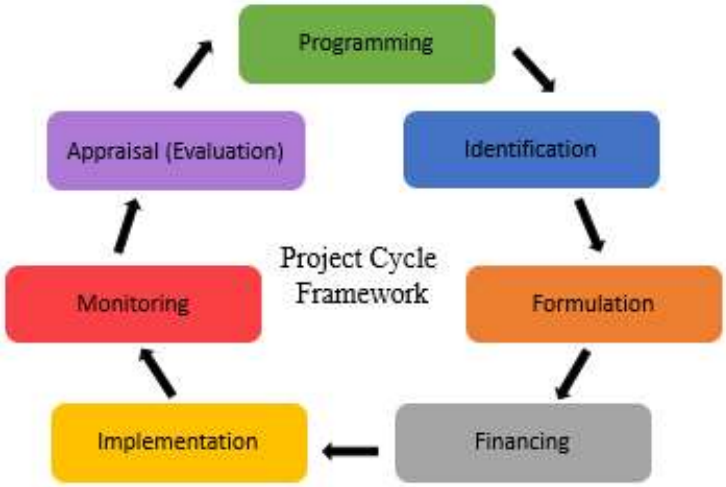

Figure 27 *Project cycle framework*

8.1 Planning procedure

Careful planning is essential to ensure that the implementation proceeds in an integrated, cost-effective and timely manner. Programming and identification of requirements are the first two phases of the PCF. All important considerations and policies of the organization need appropriate attention before the transition period can begin. The other phase of the planning process is the formulation of details of the scope, working practices and products selection. In addition, financial considerations need to be made before the process of implementation of the DBMS begins.

8.1.1 Programming phase

The first step required to move to a DBMS is the programming. It is necessary to determine the relationship between the DBMS conversion project and the organization's overall strategy. In order to be able to identify this, the organization's beneficiaries along with other

stakeholders, have to go through a participatory process to create a long-term strategy document, that includes general guidelines for the activities and projects that the organization will undertake, pointing out in which countries or regions, with which target groups and by what means. Beneficiaries are the most important stakeholders of the project or the target group. This has been expressed by Logframer (2017).

8.1.2 Identification phase

In this step, the suitability of the project is checked. Identification is a very important phase to ensure that the DBMS really meets the organization's future plans, if it matches or in other words, coincides with the organization's strategy. It must be based on in-depth knowledge and analysis of the conditions of the area and country (legal and institutional framework) and the organization's requirements from the system.

What is needed at this stage is to define the scope of the project by preparing an initial DBMS conversion plan which includes all logical interventions, as these are presented in cl500 (2017):

- Determine which organizational subdivisions will be served by the database;
- Specify which operations within the organization will use the database;
- Determine which existing and upcoming applications will be converted to the database system;
- Prepare the management proposal and get the move on.

Budget: Also in the identification phase it is necessary to assess the total budget of the DBMS conversion, looking into what resources will be required.

8.1.3 Formulation phase

In the formulation phase, all details of the project must be identified. A detailed picture about how the whole project will be done. In the DBMS conversion project that picture should provide information about:

- *Conversion team*: The Conversion team includes the database vendor team, application programmers, DBA and users representatives from each department. People with the appropriate knowledge and skills from existing employees and from people hired to enrich and strengthen this team. The leader of this team is the conversion manager who understands the business uses of the data in the record and can identify items like demographics, advanced directives, and information used for billing and coding(Dinh

et al., 2010). *Emphasis:* Tactical meetings and fix intervals management reporting for the conversion team.

- *Selection of products*: Conversion team must develop a formal proposal list with all requirements for necessary adjustments needed for the transition to DBMS from the document management system, in accordance with existing products.

- *Objectives and activities: The* Organization's objectives and activities (working practices) that are required, must be determined in cooperation with the conversion team. Planning of activities should include (1) identification of the data which will be converted, (2) methods for converting the data, (3) conversion resources, (4) identification of the programs in specific applications, (5) assess the time required to reform application programs, (6) assess the support required for data verification, and (7) develop an implementation schedule.

- *Documentation*: A set of documents to be created for the project. In fact, it is the business planning documentation, in this case that includes a review of the project, its objectives and the project management plan (PMP). The PMP shows what will be delivered, timetables, costs, and defines the structures and means of project management. It includes legal and commercial issues, project change request, risk management plan, project closure, and post-implementation reviews (Medland & Fletcher, 2016).
- *Roles and responsibilities*: For the absolute success of DBMS implementation, to be on time, on budget and within specifications, it will be based on the quality of planning and management, and the people involved. In order to ensure the best possible transition, it is essential that all who are affected by the change be made aware of their responsibilities and what they need to be doing.

- *Design database*: One of the crucial steps is that of database design. Application programmers and DBA in cooperation with other members of the conversion team must (1) identify and define all information requirements, (2) define the data requirements, (3) identify data structure and full design specifications, and (4) check and authorize the design specifications. The most important considerations when designing a database, as Ruan, Deng, and Wang (2016) identified, are:

  Flexibility: The DBMS needs to be flexible enough to store all data from the organization. During a project, the already stored data may be changed and new types

of data may need to be added. The system should be able to adapt to these changes without modifying the system architecture.

Modularity: In order to maintain high performance as the data volume grows, each module component must work on separate hardware platforms. For this reason, the DBMS must be based on modular architecture and modules must be independent of one another.

Accessibility: Considering that each module can work on different applications, the DBMS should be network-connected and support remote data access. If there is a network between the modules, end-users must be ensured of access to the stored data.

Extensibility: Since the DBMS, is an evolving system, new and better components may arise due to users' requirements and technological innovation. The system must be able to adapt to all of this. In addition, data analysis methods should be readily expanded into the DBMS so that researchers can perform extensive analysis work.

Usability: The DBMS must be sufficiently user-friendly to allow rapid understanding and ease of use. It must cater to people with different levels of knowledge and computer skills as they use the system on a daily basis. The DBMS must be designed in such a way that it will be easy to manage by users.

8.1.4 Financing phase (budgets)

The final budget proposal must be put forward before the implementation phase is launched. A detailed description of all expenses structured according to each activity must be provided. The DBMS requires cautious programming and the provision for human and economic resources to execute the wide variety of operations. All investments and recurring costs must be taken into account during the planning procedure. Once the system has been launched, the budget has to be adjusted accordingly, ensuring that there are sufficient resources to support the system and achieve its objective. As I.N.Burtylev, Mokhun, Bodnya, and Yukhnevich (2013) who refers to O'Sullivan and Sheffrin (2003) points out the cost of achieving this, the efficiency of the DBMS is considered as the results of activity achieved.

8.2 Implementation procedure

Implementation procedure begins when funding is secured. This includes the last three phases from the PCF which are the implementation phase, the monitoring phase, and the appraisal phase.

8.2.1 Implementation and monitoring phase

Implementation and monitoring phases are often performed over a period of time due to their interconnection. Implementation has to do with performing appropriate activities to meet the real needs of the organization and the monitoring system provides the correct information so that the conversion team is able to adapt the system according to these needs.

Implementation phase

The implementation phase, for the DBMS conversion project should include:

- *Practical preparation:* Practical preparation is the beginning of this phase. It involves recruiting new employees, organizing the project team at different levels and locations, creating logistics, buying new products and introducing the project to everyone.
- *Training:* A successful transition to DBMS is largely influenced by the training that takes place. Sufficient training and supervision of employees involved in monitoring is important for accurate and correct system use. Only employees with adequate training should be allowed to manage the system with regular inspections ensuring data quality and maintaining the morale and awareness of the importance of the project throughout the transition. In addition, periodic in-service training sessions are essential. For effectiveness and efficiency in the DBMS training, the three steps that must be carried out before the training for end-users are: (1) creation of the requirements and the training schedule according to the organization's and individual (employee) needs, (2) find the 'teachers' for the training. Programmers with sufficient knowledge and skills to use data management language are the most appropriate. And (3) training of the DBA in data manipulation control language and data definition language.
- *Database installation and testing:* In the implementation phase the database is installed and controlled. For effective installation and testing as presented by (cl500, 2017) the requirements are: (1) code DMCL, schema and sub-schema, (2) modify representative programs for DBMS test, (3) code conversion programs, (4) generate the database, (5) test and debug, and (6) review and approve test results.
- *Expand detailed conversion plan:* Creating an integrated conversion plan that includes (1) modifications to the individual schedules for each program and each file to be uploaded, (2) a data verification programme to ensure accuracy, completeness and so provide a real indication of their status and value, (3) programming computer

availability, (4) development of the official conversion program and obtain commitments from all stakeholders involved, and finally, (5) approve the conversion.

- *Applications conversion:* The correct conversion of existing applications is an important activity. Modern industry bases a lot of its success on the use of applications. (1) Conversion of applications one at a time, (2) correct and update the database according to the needs that have arisen, (3) give the green light to revised applications to be integrated into the system, and (4) start using the database for new applications and programs.

Monitoring phase

The monitoring phase is the check whether the project (activities, goals and budget) goes according to the plan. Monitoring is essential for the flexible adaptation of the project in line with the ever-changing needs and continued growth of the industry. Especially for the DBMS which is a constantly evolving system. It is a requirement to track DBMS access indicators and end-user performance, and make the appropriate modifications, adjustments to the database according to the needs that arise.

One other way of monitoring the system is through the use of feedback. Encourage feedback from end users in order to understand the effectiveness of the system to respond to the organization's needs. In addition, monitoring can also indicate when the database needs renewal, so that it may meet the organization's new requirements. Therefore, the DBMS must always be adequately flexible allowing it to permit periodic adjustments.

8.2.2 Appraisal phase (evaluation)

Creating or developing a DBMS requires continuous evaluation to ensure its success. This is crucial for the efficient operation of the system and its long-term viability. There must be continuous control by DBA and end-users to identify and resolve any problems that may arise. The appropriate resources that will be needed to solve these problems should be part of the project budget.

Additionally, it has to be considered whether the system offers the desired results to achieve the organization's goals and that it actually supports and enriches the organization's work process. Calculate the level of success of the database and redefine organizational objectives and information requirements or start a new database plan if recommended by the evaluation.

8.3 Conclusion of planning and implementation procedure

Consideration of the many factors that will ensure that the project to convert to DBMS will succeed is of paramount significance. The planning and implementation procedure should be prepared carefully and methodically, following the phases of the PCF, in order to organize everything that is needed, to be cost-effective and timely. Infrastructure requirements and objectives should be set so that the database is in line with them. But as Clay et al. (1998) mentioned in their report 'No system is perfect and it is not until the programme has been up and running for some time that all the major obstacles will be overcome'. This means planning and implementing the system based on the organization's requirements, however engagement, dedication, changes, and hard work are necessary to achieve the desired results.

Chapter 9 Data Migration Strategy

Converting to DBMS requires great preparation before and during project execution. As described in chapter 8, in the planning and implementation procedure of the project many individual plans must be created and many critical decisions should be taken. One of these is the data migration strategy that the organization will follow. It is one of the most important processes during the transition period and requires good planning and preparation of how this is going to be carried out. This chapter, provides a systematic way of successfully migrating data, ranging from the selection of strategy and different options of data transition. It also presents key steps in the data migration methodology and the mitigation of the typical risks of this process.

9.1 Migration strategies

The first step that needs to be taken when it comes to creating a data migration strategy is to look at the style that best suits the project requirements and the available migration time. There are many types of strategies and the choice made will be according to the organization's requirements. However, the two main types of data migration strategies are the big bang migration and the trickle migration(data-migrations, 2017; Oracle, 2011).

Big bang migration: All work procedures stop, applications and databases turn off, and all attention is paid to the data migration. Taking into account the short data migration time required, combined with eliminating the risk of errors and other adverse events, this looks like a really attractive option. On the other hand, the fact that it is a mandatory interruption of the systems so that data will not be available for a period of time, means that it can be detrimental to workflow, especially when the organization's work is based on real-time data. Organizations that choose this type of strategy in order to minimize the negative effects, begin the migration process after working hours or during holidays, thus reducing the problems that will arise due to the unavailability of the data.

Trickle migration: The migration process does not occur throughout the system at the same time but only function in a selected area so that workers can access the data throughout the migration process. Most organizations work 24 hours a day, all days of the week and on public holidays, so they run uninterruptedly all the time. Thus, the cost of disabling the systems is enormous. By using trickle strategy, the organization's work process is not interrupted because the system continues to operate. On the other hand however, the migration process takes a long time and needs careful and good planning because it becomes more complicated.

To summarize, there are two approaches to data migration strategy. The first, big bang migration, transfers the data as quickly as possible, but it is mandatory to shut down the system. The second is the trickle migration which is much slower, but can take place in parallel with the normal work of the employees and systems of the organization.

9.2 Options of transition

Each organization should consider the proper way of managing legacy data and information. There are a number of options, but the most appropriate one depends on the requirements combined with the risks and opportunities that have been identified. Department of Finance and Services of NSW government (2013) presents the five data transition options. Each option includes a combination of keeping data and information in replaced formats or systems and/or converting or migrating of data and information to new formats or systems.

1. Migration of all legacy data or information (with the appropriate metadata) to the DBMS and upon the completion of the transition, the reconsideration and the confirmation of mitigation success, data and information should be destroyed according to the organization's destruction plan;

2. Migration of only the ongoing data and information (with appropriate metadata) to the DBMS, set the governance and management requirements needed by the new system to support the legacy data or information. Maintain the remaining legacy data and information in the system being replaced until it is destroyed;

3. Transfer some legacy data or information (with appropriate metadata) to the digital archive of records (state records), and migration remaining legacy data or information (with appropriate metadata) to DBMS;

4. Transfer some legacy data or information (with appropriate metadata) to the digital state archive (state records), and maintain the remaining legacy data and information in the system being replaced until it is destroyed;

5. Keep all legacy data or information into the replaced system until it is destroyed.

Regardless of which is selected, the capacity, operability and resources should be safeguarded by the implementation of suitable controls on data and information during and after migration.

In addition, the new data and information environment must incorporate robust information management controls and data delivery mechanisms.

9.3 Data migration methodology

The explanation of data migration, to transfer data from one system to another, may seem an easy operation. However, it takes a lot of time to plan and correctly validate the migration. This is why the full migration process can take much longer than the time required to extract, transform, and load data into the new database. The following methodological phases should be considered when data migration is to take place.

- *Migration team:* The migration team, usually members from the conversation team, should know the existing systems, have mapping for the new system and the programming work can utilize the overcapacity of staff, thus the data and information can be uploaded into the new database according to the adopted timetable.

  Notes: It is important to know the impact on the organization's users. Employees must be informed and ready for this process. They will not have access to data for a period, and it is important that migration does not affect their work on a large scale. And in order to do this, the migration team needs a list of procedures and functions related to the data and information that will migrate so that employees are timely informed and made adaptable to their work.
- *Data requirements:* This phase includes three steps. Firstly, the exact definition of requirements for extraction, transformation, loading and control processing. Secondly, the detailed requirements for validating data (quality), such as relevance, accuracy, integrity, consistency, completeness, timeliness, accessibility, and compliance (Oracle, 2011). And thirdly, is the development of a data cleansing method for detecting and correcting invalid or incomplete data

- *Data preparation:* Data preparation is the next phase and includes three steps. The first thing that must be done is to find the data which needs to be loaded. Secondly, is the data quality assessment, in other words to highlight the quality of the data, its level of importance and to determine the extent of the migration. And thirdly, data cleansing which means that all unnecessary data elements have to be removed, all bugs are corrected and inconsistencies are clarified, in order not to transfer all of them into the new database.

- *Data identification:* Coding structure by following the structured programming rules. It is essential to have a logical structure in the database. The database must be organized in order to make it easier for programmers and maintenance managers to define which modules and routines execute which operation (comptechdoc, 2017). The data configuration follows. This step determines how to manage the software versions. Make sure that it is comprised of a detailed procedure for controlling software changes (Tierstein, Systems, & Ltd.). Neat separate data in categories such as the master data and sub-master and to the transaction data. And the final step is the data cleansing (finding defective or missing data).

- *Understanding data:* Collect all the relevant information about the complexity of the data migration. Learn as much detail as possible about software and hardware, such as the new location of the data, activity line, and product types.

- *Mapping and design:* Mapping is the process that shows from where migration tools will get the data (source system) and the new location to be stored (destination system). The new and old position cannot be the same, and after the mapping is planned, the two positions cannot be changed.

- *Planning migration:* Planning phase must be prepared with due diligence, be complete and take into account all the relevant information on the correct migration plan, such as the organization's restrictions on migration, migratory tools, data and their characteristics, as well as migration practices (data-migrations, 2017). Estimation of the budget and timeline for the whole migration process from material cost, creating mapping and loading to validation. Planning all the details, small and large to allow the migration team to monitor and control without omitting anything that may end up causing problems. At this phase, it is also necessary to set up a data governance team on the part of the organization, which would be empowered to take decisions, lead the actions and be responsible for the success of the new system.

- *Executing:* The data executing phase begins with the extraction of data from the source system (DMS), after the data is transformed, followed by quality control (data clearing) and eventually the data is loaded into the destination system (DBMS). All steps are done according to the predefined requirements.

- *Testing:* Data is of great value to organizations, when a migration of it is to take place, it must be ensured that this be done successfully. For this reason, migration testing must

be performed before the real one begins, in order to minimize errors and omissions due to poor preparation. This phase checks if the preparation was correct and the migration tools were correctly selected. A small but representative part of the data should be included in the test.

- *Migration:* Moving into action, when the DBMS infrastructure is ready, the predefined data that has been decided to be transferred to the DBMS, are then moved there. Ensuring that everything is done correctly and in accordance with the plan, data control can be applied to any data set at any point in the migration process.
- *Validation:* When all data has been migrated into the new system, final control is required if migration has been done as it should. Even when all looks to be successful, mistakes that may be well-hidden and exist, need to be detected and erased early to avoid database interruptions in the future.

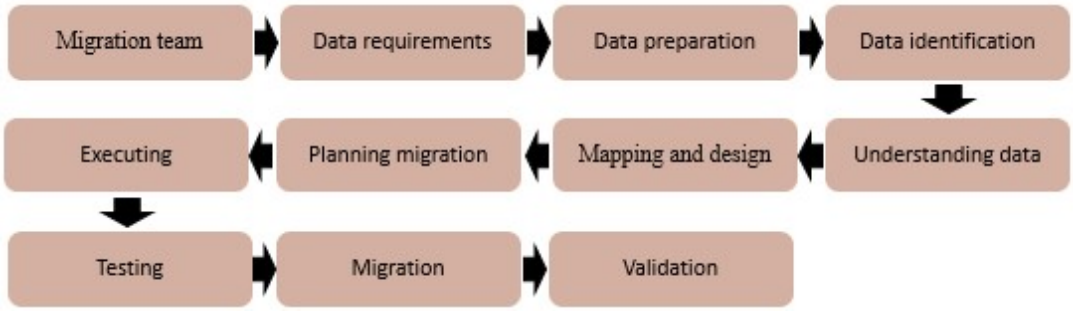

Figure 28 *Data migration steps*

Careful and methodical preparation is required. Irrespective of the organization's strategy, each data migration plan emphasizes the above steps (figure28), which are required one by one for the proper migration of data. Although some steps seem unnecessary, the omission of any of them significantly increases the probability of migration failure.

9.4 Risk and mitigation

Data migration is a complicated and demanding process and hides several major risks. Paying attention to the beginning of migration may reduce the risk, however it does not eliminate it. It is mandatory to be well-prepared for the whole process as data is the most valuable resource of today's organizations and a mistake can lead to unpredictable results. Attention to the following risks and their mitigation is important.

Poor quality of data will cause problems in migration and will bring issues into the new system. Assessing the quality of the data in a timely manner allows for the discovery of issues before

migration starts,(Sundareswaran, 2013) providing more chances to deal with them through cleaning or changes to help avoid situations that will create problems with the migration or future operation of the system.

Changes to the DBMS will affect data migration process. To avoid these issues, the migration process must start from the most stable areas of the DBMS. Excellent cooperation between the migration team and the conversion team is essential.

Changes to the DMS will affect the data migration process. For any changes to the DMS, the migration team must be updated in order to make appropriate adjustments.

Migrated incorrect data. This is data that has been incorrectly transferred. Detailed checks and controls are necessary to reduce the probability of mistakes.

Data loss. The selected data that is not to be transferred to the new system, needs to be written on a list where directly affected elements, such as employees and customers, will confirm that it is not needed any more.

9.5 Conclusion of data migration strategy

A series of procedures, which have been well-analysed and processed, are required for the data migration process. Migration strategy should be selected according to the needs and requirements of each organization. The migration plan should make it possible to understand what needs to be done, but also to determine what is expected at the end of migration. The above steps demonstrate a good basis for conducting an effective data migration process, but each organization is different and may require a somewhat different approach.

Chapter 10 Suggestions

After having looked at all challenges separately, a scenario in which will be presented a series of activities on how an organization should executed the project, including all challenges, is suggested. In addition, we need to take into account minimal but basic advisement for strong and fundamental change when moving to DBMS for strong and fundamental change. It is also important to look at the disadvantage of the DBMS in order to be aware and ready to deal with them.

10.1 Suggested proposal

The proposal is to develop scenarios, making all the necessary adjustments to deal with before a real situation arises. The objective is to first check in a non-real world how all these challenges can be put into practice before the actual act, all together in a project, not in a separate way as this thesis presented. That is actually the creation of a data conversion strategy which may adjust to changing organization's needs. A strategy in which everything shall be included, from the preparation of employees to accept the new system until the data migration process and on which the scenario must be based. In other words, develop a scenario-based approach to strategic planning. Scenario planning is based on the assumption that future developments are largely uncertain. Thus, the basic idea of scenario planning is to force managers to acknowledge this uncertainty and to translate it into thinking in multiple options (Wack, 1985).

Following Wulf, Meissner, and Stubner (2010) scenario approach, the starting point is the frameworks for strategy-building which incorporate all perspectives that are needed for the project, including human psychology, requirements, work process, risks, resources, planning and implementation procedure, which shall meet four essential requirements:

- *Multiple options*: Should consider different strategy options to address corporate turmoil and prepare the organization for the variety of possible outcomes.
- *Multiple perspectives*: Should look at views and information from various stakeholders to challenge existing affairs and overcome resistance.
- *Systematic tool-based process*: Should have a clear process for which specific strategy tools are determined to allow easy and fast implementation in practice.
- *Flexibility*: Should be adaptable to different conditions to facilitate implementation.

After the creation of an integrated strategy framework the scenario design takes place. Figure 29 illustrates Wulf et al. (2010) scenario approach, which is organized into six steps, each of which is linked to a standardized tool.

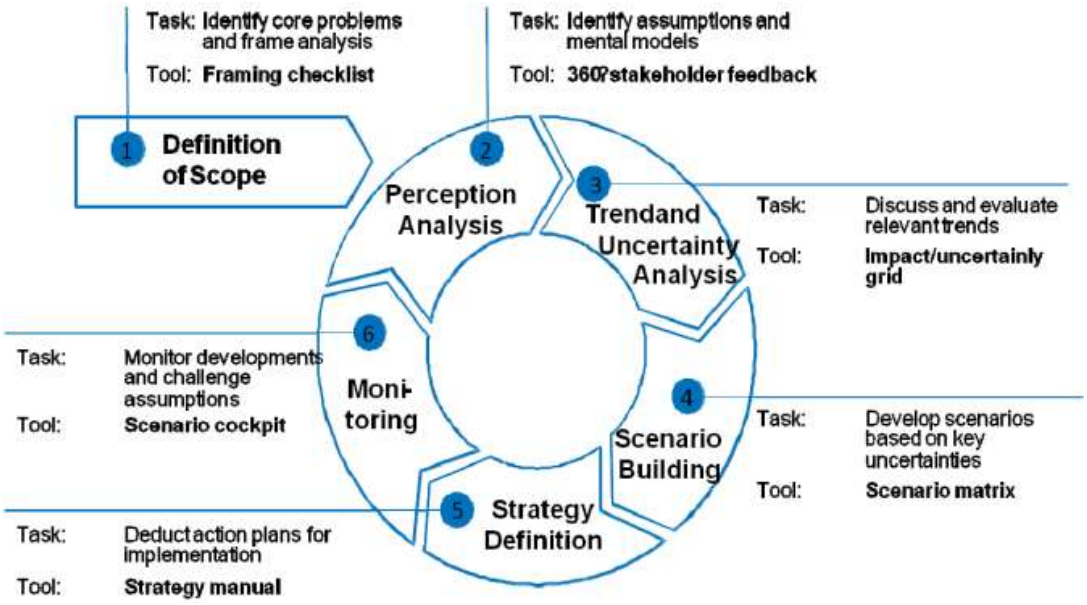

Figure 29 *Overview of the scenario-based approach to strategic planning by Wulf et al. (2010)*

- 1st Step _ Definition of scope: Determine the objective of the planning project, using framing checklist as a tool that defines the objective, the time horizon, the participants and the strategic level of analysis. In this way, ensuring that all participants align with the same objectives for the strategic planning process.

- 2nd Step _ Perception analysis: The viewpoint of people involved in the data conversion planning procedure is recognized and questioned. The objectives of this step are in principle to establish a comprehensive list of aspects that can influence the future of the organization such as the influencer evangelists, secondly assess these aspects on the basis of the likely impact of their performance and their level of uncertainty, and finally compare the perspectives of different participants groups about these aspects. The tool that can be used here is the 360 ° stakeholder feedback.

- 3rd Step _ Trend and uncertainty analysis: Significant trends and crucial uncertainties that may affect the future of the organization are analysed by the scenario team. The tool proposed to be used here is the impact / uncertainty grid. This tool contributes to the depiction and structure of the list defined by 360° stakeholder feedback and includes

aspects that may affect the future of the organization. It is a grid (matrix) that places all the defined aspects on the basis of their likely impact on performance and the level of their future uncertainty. The more an aspect affects the performance the higher its position in the matrix and the more the level of uncertainty of it, the more it is located to the right-hand side of the matrix.

- 4th Step _ Scenario building: Using a scenario matrix as a tool, in that step it is used to develop and describe the scenarios for an organization. The scenario matrix is a visual framework for the production of scenarios. Using two key uncertainties which must be defined from the previous step, as the dimensions covering the matrix can be referred to as scenario dimensions. For each of the two uncertainties, two extreme values have to be determined resulting in four separate quadrants giving four future alternative scenarios.

- 5th Step _ Strategy definition: This involves the creation of specific strategic alternatives and implementation plans for the conversion. The different strategies created at the beginning are tested against the four scenarios developed in the previous step to develop new strategies. Strategy manual is the selected tool, which consists of three phases that must be specified for each scenario. Firstly, the condition in the macroeconomic environment, the possible reaction from competitors and customers, the proposed position of the organization, the competitiveness strategies and the programming of value chains and action plans. Secondly, with the results of the first step for each scenario, is to identify the strategy components that are common across all scenarios. And finally, describing in detail and comparing the main strategy with the alternative strategies and thereby create a basis for decisions on strategic changes.

- 6th Step _ Monitoring: The scenarios are stable compared to actual developments. And this allows organizations to analyse early enough whether reality is close to a specific strategy by showing the strategic choice to be performed. Wulf et al. (2010) developed for this step the scenario cockpit tool, which consists of three phases, firstly, for each scenario, key indicators are identified, secondly, values ranges are set for these indices and eventually there is continuous monitoring of the identified indicators. The outcomes are later visualized and periodically displayed to decision-makers.

I presented Wulf et al. (2010) approach, however most scenario approaches follow these process steps in one way or another.

10.2 Additional suggestions

Following this scenario to create the conversion data strategy which will contain all recommended solutions that will help to meet each challenge, suggestions must be made to adapt it in order to fully exploit its potential. Here are some of the basic suggestions when data strategy is to take place:

- *Avoid to guide policy based on the tools*: Many dynamic selection tools are available today to develop a strategy for converting the data system. However, it is important that these tools do not divert attention from the use of old but successful methods (tools) that do what needs to be done. In addition, the tools must go hand in hand with the project to be carried out
- *Plan yes but adjust the plan when needed*: The goal is to successfully transform the system, not to maintain the plan. Plan in a comprehensive way within the required steps, not in a complicated and detailed way because it will get the attention from the project. Be ready for changes as requirements and needs change, so plans have to be adapted.
- *Budget*: Resources for the execution and management of the data project must be evaluated, made available, recovered, assigned and purchased. Resources should be identified and used in the most appropriate way. A budget for data resources should be available if organizations want to be at the top, although the best thing is to stay within the original budget limits.
- *Know the participants*: Every person who influences the conversion process and the data life cycle after the conversion has to have a voice and be part of the project. People at all levels, whether friends and not, regardless of personal friendships and confrontations, the criterion must always be that they are the most appropriate people for the task.
- *Transparency*: Ask key people for tips to win their valuable contribution (McDonald, 2017). Excessive secrecy can lead to major problems such as distrust, inefficiency and resistance, especially at the beginning of a project, when requirements are created.
- *Monitoring*: It is important to know the tasks being performed, who does what, what comes after and if something is needed to change the project. After the transition period, monitoring not only the maintenance and resource parameters, but also the data process

and services reporting, especially when the data functions are beneficial to the organization.

- *Authorized thoughts*: DBMS interact with many different technologies, and not only that, data is more detailed and visualized, creating issues related to internal and external users. Analyse the impact of these two groups if they need to have a different authorized accessibility during the planning is important. In addition, many groups of DBMS-related organizations have access to the data. The way in which these groups will be dealt with, should be considered in advance.

- *Data life-cycle*: Processes and transformations which data have to pass, from raw data to retirement, should be understandable by all interested parties, in order for the data processing process to be effective and efficient.

- *Ongoing support*: People greatly influence the data work, software or process, regardless of how automated or algorithmic it is. People will face change and difficulties during the transition phase, as well as during the data life-cycle process. Planning is different from reality and they will address that. Encourage and stay close to them and be ready to help, it is important.

- *'Buy' the proper resources*: Identify where you need resources, such as new applications, or skilled professionals, and how resources will be used. The first search place is the existing resources of the organization, in order to avoid the 'purchase' of incorrect products. Categorize them according to their importance, the use of time, the amount of data they need to manage, the type of data they will manage, choose technologies close to the knowledge and skill levels of employees, and other critical factors.

- *Collaboration tool*: People involved in a project should be able to communicate and exchange information using a communication platform and specific tools. People in other groups probably use other types of tools to support different tasks due to the different needs of each workflow. However, it is necessary to have a collaboration tool that can be used by all members, regardless of the team and work, where they can communicate and exchange information such as email and messaging.

- *Knowing the planning*: One must keep in mind what is running and why it is not running during a project so that all participants are able to know.

- *Questionnaire*: Creating a questionnaire for organizations which have already launched their transition scheme or are thinking about it. Asking questions such as the critical problems they found, how they solved them, what is their greatest fear are only some of the issues that can be included.

The above suggestions are just a few small tips that an organization which is considering a conversion to a DBMS is wise to keep in mind to integrate them into the planning, implementation and data life-cycle process.

10.3 DBMS limitations

Chapter 2 discussed the advantages that the DBMS is as a server to an organization. However, it is important to take into account the disadvantages / limitation of the system so that they do not come as a surprise after the implementation. The main disadvantages are:

- *Costly*: Advanced technology (hardware and software) and skilled staff are needed in the deployment phase and throughout the system's life-cycle in order to maintain high efficiency. The costs required for training, licensing and regulation must be included in the lifetime costs of the systems.

- *Multiple sources*: DBMS is an open system that interacts with multiple technologies and affects resources and the character of an organization to a high degree. Corrective actions to the change allows for a smooth introduction of the system and thereby ensuring that it contributes to the organization's goals. Security issues need to be continually evaluated due to the multiple access.

- *Ongoing improvement*: In order to maintain the effectiveness of the DBMS, updates are needed on a regular basis and the new corrective measures must be implemented at all levels. DBMS is always rapidly evolving, employees need regular training, and technology investments are needed. However, DBMS is an excessively expensive technology investment and this creates a strong link between organizations and DBMS vendors, due to the high cost of this change. Therefore, organizations are trapped in the vendors' offers and choices.

- *Mandatory changes*: Upgrades and replacements for the system occur very often. Many of these new versions require upgrades of software or hardware. This results in additional emergency costs, as well as training costs for DBAs and end-users (Equizine, 2012).

When an organization makes the decision to convert from DBM to DBMS it should fully understand the limitations of the system that it wishes to implement. The organisation must be aware that it is more expensive, complex to implement and is not practical for average organizations.

Chapter 11 Conclusion

The objective of this thesis was to study the challenges of converting to DBMS and thereby help Drage AS support its clients during this process. To a great extent this has been achieved. While a universal and specific solution was not achieved, this thesis suggests interesting points to the company about how to direct its clients in the right direction when they are making this transition. With further effort, better and more accurate solutions can be achieved.

The research literature has shown that organizations are turning their attention to DBMS to help them better manage their information and solve the problems that DMS has created in their workflow. The main problem is the use of the documents as databases which results in the creation of data silos, a large number of data entry points and a waste of time and effort to find the data. The transition to DBMS is solving those problems. This is being accomplished through the use of data in a database which creates, retrieves, updates and manages the data in an automatic and systematic way. It is the bridge between the database and the end users or application programs from different locations, in this way providing easy access to data in an organized environment. However, the challenges to convert to DBMS are many and if not enough attention is given to these challenges then the conversion will fail.

The first challenge when a change takes place in an organization is that of human psychology. This was given a great deal of attention and was a core element of this thesis. Surveys have shown that the underlying causes that will lead to resistance to the implementation of the DBMS can be accounted for by three factors. Firstly, employees are reluctant to accept any change in their working environment, secondly they fear that they will not be able to manage the new system, and thirdly because they do not know when, how and why the transition will begin.

This thesis has discussed the use of change management methods and has proposed this tool as a solution to this challenge. In particular, by developing a performance management system, organizations can combat the reluctance. Building a pathway linking all people involved to participate in the process to aid in the comprehension and adoption of the DBMS. This would always need to be based on individuals' needs and practices. By identifying the new skills required and planning the training program the fear of disability can be combated. For a better and substantive way to cope, a DBMS training program was suggested. This would be carried out through the use of an adult-learning cycle. Following this the importance of creating an effective communication plan was discussed and analysed. This would need to be carried out

with the help of influencer evangelists, in this way advancing the organization so that it will be better informed about the implementation process during the transition period, thereby destroying with this, the last factor, the fear of the unknown. Finally, in this challenge, it was proposed to develop a reinforcement method in order to help the organization to make the appropriate adjustments when needed.

The second challenge that was analysed was the current industry requirements from the DBMS in which DBMS professionals of organizations and vendors need to fully understand and be prepared to deal with these industry requirements. The key issues that emerged from the research are the transition to a multi-application database platform, the understanding of unstructured data, both cloud and on-premises management, as well as database security which is always an important issue. A useful way of dealing with them has been found to be the creation of a record of a comprehensive set of processes to ensure integrity and security. Preventive actions to control applications' performance and their impact on the database, by utilizing the daily experience of users. The final element of this challenge was presented, namely, how to manage unstructured data by creating different types of data, then consolidate the data, removing redundancy to the fullest extent possible.

Understanding crucial factors that will influence the working process when implementing a DBMS was the next challenge presented by this project. For a flexible, fast, and valid system, database design and software development should follow the principles of data processing. This can be achieved by understanding the functions being performed. Raw data, should be safely stored but easily accessible for analysis. The organization with the help of DBMS vendors should choose the most suitable database for its requirements, using a software development life cycle for more effective results. The creation of software evangelists within the organization and the ongoing collaboration between the two is important throughout the life of the system. In addition, to gain all the benefits that the system offers, the system must direct the end user, providing facilities such as help and local language selection. Data visualization and fusion as well and BI are also suggested for better HCI. The next element focused its attention on the importance of developing flexible and easy manageable web-based tools for fast, accurate, and secure data entry. Tactical operations and maintenance, systematically re-evaluating and system upgrade, is the means to ensuring that the system is following its objectives. Finally, it is imperative to provide control and secure information platform for access and data distribution that guarantees the integrity and confidentiality of data in the database.

Emphasis should be placed on the threats and risks that arise when establishing a DBMS. Implementation risks associated with the project management team's capabilities to develop an integrated conversion strategy and their power to act on problems are essential. Additionally, risks connected with the organization's requirements and rules, must be identified and included in the project. Furthermore, and finally, one needs to take into account the dangers arising from the structure and operation of the system.

Attention needs to be given to the security system which covers the system in terms of prevention, detection and rehabilitation, as well as the three basic requirements of confidentiality, integrity and availability. Existing security controls need to be strengthened and improved on an ongoing basis. This thesis mentioned three improving actions, data fusion and visualization to investigate threats, integrate native privacy protection mechanisms by paying attention to the activities being performed and artificial intelligence technology to cover people's disabilities.

The next challenge was the identification of the types of resources. The fact that this work does not analyse a particular case, made it difficult to be precise about the resources required because every industry or organization is different. In general terms, resources affected by the DBMS transition are, people, hardware, software, data and the network. According to each organization's needs, all appropriate configurations and modifications must take place for each of them. The first step is to search in existing resources what is missing and then look for the best solution for what does not exist. Estimate skills and knowledge of existing and new workers and select technologies according to them. Choose people who fully understand the skills and requirements of the organization, are networked and able to share data between multiple users and multiple locations and develop a software strategy according to the organization’s requirements for the system.

Significant importance must be given to planning and implementation procedure during a transition process. This project proposed as a tool to manage that important challenge in an integrated, cost-effective and timely manner, the project cycle framework. All the crucial considerations and actions that need to be considered and taken, when a DBMS is going to be established from planning to final integration are presented. People with the suitable skills and knowledge should be in the right positions to carry out planning a database in a context with the organization’s requirements and objectives. Current activities and database design is essential to be in the context of realistic and feasible changes within a reasonable time. It is

essential to monitor the process by estimating indicators and end-user performance in the system and adjusting accordingly to the resulting requirement. Finally, it was pointed out that there needed to be periodic evaluation to determine whether the system provides the desired results to achieve the organization's objectives until the final installation.

The last challenge discussed in this work was to define a migration strategy for legacy data and information. Strategy shall be selected according to each organization's needs; those discussed were, fast but system out of function big bang migration and slow but system in function trickle migration. Research showed that a significant amount of sets of technical applications and people with skills, supported by tools are required for successful data migration.

After having completed the analysis of all challenges separately as requested of me, there was an important practice identified as an area of improvement and suggested on this subject. It concerned that of the development of a scenario-based approach to strategic planning that will present all challenges to a series of activities on how an organization should carry out the conversion. Figure 29 summarizes step by step how to develop an effective scenario. In addition, at this point some general tips for a better data conversion project were presented, as well as the main limitations of the DBMS, so that if only a part of the conversion strategy was forthcoming then this would not come as a surprise.

This thesis analysed many issues which need attention during the transition to DBMS, providing many critical tools and solutions for a successful transition, secure from risks and threats. The most important contribution of this thesis comes from summarizing in a project the many important issues that an organization has to face today in this particular change. It provides tools and methods that resulted from a careful and qualitative research, touched upon critical aspects in a way, so as to be better understood and more suitable for every industry plant. By paying attention to these challenges in the way that this project provides, the transition period will be smooth and free of problems, ensuring the successful installation of the system. Eventually, the suggestions for overcoming these challenges can be applied in a real case project. This thesis is a step in the right direction because its approach allows us to understand and solve the challenges that arise in the transition to DBMS and in combination with the help of the suggested scenario solution which the organization can rely upon to develop a transition strategy in a reliable, usable and structured way.

Bibliography

Acunetix. (2017). SQL Injection (SQLi). Retrieved from https://www.acunetix.com/websitesecurity/sql-injection/

Adenle, C. (2014). Infographic: Why Employees Resist Change. Retrieved from http://catherinescareercorner.com/2014/02/21/reasons-employees-resist-change-guide-resistance-infographic/

Aiim. (2017). What is Document Management (DMS)? Retrieved from http://www.aiim.org/What-Is-Document-Imaging#

Anderson, K. A. (2015). Communications plan kerry anderson_submitted. Retrieved from https://www.slideshare.net/kerryannanderson/communications-plan-kerry-andersonsubmitted

Arizona, T. U. o. (2017). Research Data Life Cycle. Retrieved from http://data.library.arizona.edu/research-data-life-cycle

Ashwin.S. (2009). Information Systems and Technologies. Retrieved from http://seminar4u.blogspot.no/2009/02/information-systems-and-technologies.html

Askarka. (2015). *TALENT MANAGEMENT SERVICES*. Retrieved from http://www.askarka.com/talent_management_services.html

Aveda, S. (2015). What is the importance of a database management system? Retrieved from https://www.linkedin.com/pulse/what-importance-database-management-system-scott-aveda

Bracken, J. (2014). *The Important Difference between Change and Transition* Retrieved from http://quality-texas.org/wp-content/uploads/2014/11/The-Important-Difference-between-Change-and-Transition.pdf

Brusati, I. (2017). THE RESISTANCE PYRAMID. Retrieved from http://isabellabrusati.com/the-resistance-pyramid/

Canada, C. F. o. (2017). *Keeping the Right People*. Retrieved from http://hrcouncil.ca/hr-toolkit/keeping-people-performance-management.cfm

Carlos, C., & Rob, P. (2009). Database Systems: Design, Implementation, and Management. Retrieved from http://databasemanagement.wikia.com/wiki/DBMS_Functions

cl500. (2017, 09 May). Database Implementation Procedure. Retrieved from http://www.cl500.net/implementing.html

Clay, P., Cowx, I., Evans, D., Jr., F. G., Grainger, R., Gumy, A., . . . Zwieten, P. v. (1998, 18-30 May 1998). *Guitelines for the routine collection of capture fishery data.* Paper

presented at the 1997, Guidelines for the routine collection of capture fishery data. Prepared at the FAO/DANIDA Thailand, Bankok.

Colombo, P., & Ferrari, E. (2016, 16-20 May 2016). *Efficient enforcement of action-aware purpose-based access control within relational database management systems.* Paper presented at the 2016 IEEE 32nd International Conference on Data Engineering (ICDE).

Commission, E. (2017). *Life Cycle Data Network*. Retrieved from http://eplca.jrc.ec.europa.eu/LCDN/developer.xhtml.

comptechdoc. (2017). Code Structure. Retrieved from http://www.comptechdoc.org/independent/programming/programming-standards/code-structure.html

Crooks, R. (2015). *16 Captivating Data Visualization Examples*. Retrieved from https://blog.hubspot.com/marketing/great-data-visualization-examples#sm.000jkoxa51294f6awye29jhr1bu3q

Cushman, C. (2013). Data Management and Information Systems University of California, San Diego. Retrieved from https://hnrp.hivresearch.ucsd.edu/index.php/research/investigator-resources/resources-offered/dmis

Cvrček, D. (1998). *Access Control in Database Management Systems*, 1-9. Retrieved from http://www.fit.vutbr.cz/~cvrcek/confers98/datasem/datasem.html.cz

Dada, G. (2016, March 11, 2016). Subscribe to Data Informed Key Challenges Facing the Modern Database Administrator. Retrieved from http://data-informed.com/key-challenges-facing-the-modern-database-administrator/

Darren. (2009). The Trainer aka Change Manger. Retrieved from http://www.logicoolsolutions.com/learnDoMasterChallenge/the-trainer-aka-change-manger/

data-migrations. (2017, May 2017). DATA Migrations. Retrieved from http://www.data-migrations.com/

Dawn. (2015). KP: Mechanism to redress puplic grievances on the cards. Retrieved from https://www.siasat.pk/forum/showthread.php?348581-KP-Mechanism-to-redress-public-grievances-on-the-cards

Dcosta, A. (2013). Change Management: Remembering That We're All Human. Retrieved from http://www.brighthubpm.com/change-management/53837-change-management-the-human-factor/

Deepika, & Soni, N. (2015). Database Security: Threats and Security Techniques. *International Journal of Advanced Research in Computer Science and Softw, Volume 5*(Issue 5), 622-624.

DeepTalent. (2016). Track The Employees With HR Talent Management Software. Retrieved from http://deeptalent.blogspot.com/2016/08/track-employees-witha-hr-talent.html

Dhingra, M., Jain, M., & Jadon, R. S. (2016, 22-24 Dec. 2016). *Role of artificial intelligence in enterprise information security: A review.* Paper presented at the 2016 Fourth International Conference on Parallel, Distributed and Grid Computing (PDGC).

Dinh, A. K., Kennedy, M. S., Perkins, S. G., Peterson, L. L., Warner, D., & Washington, L. (2010). Migrating from Paper to EHRs in Physician Practices. *Journal of AHIMA 81, no.11* 60-64.

Draga. (2017). Retrieved from http://www.draga.no/

Equizine, S. C. R. M. a. E. P. L. (2012). *Advantage and disadvantages of database management system*. *Equizine Sr. Client Relationship Manager at Equitec Pvt Ltd.* Retrieved from https://equizine.wordpress.com/2012/10/22/advantage-ans-disadvantages-of-database-management-system/

Essex, U. o. (2017). CREATE & MANAGE DATA RESEARCH DATA LIFECYCLE. Retrieved from http://www.data-archive.ac.uk/create-manage/life-cycle

Fatima, H., Satpathy, S., Mahapatra, S., Dash, G. N., & Pradhan, S. K. (2017, 26-27 March 2017). *Data fusion & visualization application for network forensic investigation - a case study.* Paper presented at the 2017 2nd International Conference on Anti-Cyber Crimes (ICACC).

Feikis, J. (1999). Secure database management systems. *IEEE Potentials, 18*(1), 17-19. doi:10.1109/45.747239

Fricke, P. (2015, December 10, 2015). Subscribe to Data Informed How to Address Top Challenges of Database Management. Retrieved from http://data-informed.com/how-to-address-top-challenges-of-database-management/

Fuqua, M. (2012). *Data Centric Vs. Document Centric*. Retrieved from http://www.availdata.com/blogArticles/Data-Centric-Vs-Document-Centric.cfm

Galpin, T. J. (1996). The Human Side of Change: A Practical Guide to Organization Redesign.

GoogleCloudPlatform. (2016). Digital Media Asset Management And Sharing. Retrieved from https://cloud.google.com/solutions/scalable-digital-media-asset-management-serving-sharing-solution

Grigg, T. (2017). Avoid these Five Mistakes When Setting Up Your Database. Retrieved from http://www.dbmarketing.com/2010/03/900/

Guerrero, A. (2013). *Five Best Practices for Training Staff on Using a New EHR*. Retrieved from http://profitable-practice.softwareadvice.com/five-best-practices-for-training-staff-on-ehr-0513/

I.N.Burtylev, Mokhun, K. V., Bodnya, Y. V., & Yukhnevich, D. N. (2013). *Development of Electronic Document Management Systems: Advantage and Efficiency*.

IU, I. u. (2015). Computer Literacy Assessment for Incoming Students. Retrieved from https://online-shc.com/clt/clt.php

Kazz, V. (2015). What Is A Document Management System. Retrieved from https://medimicro.com/what-is-a-document-management-system/

Keillor, C., & Keillor, C. (2014). Article: Engaging Adult Learners With Technology. Retrieved from https://digitalleaningfellowship.wordpress.com/tag/adult-learning-cycle/

Keka. (2016). Step by step Talent Management Process. Retrieved from https://www.keka.com/talent-management-process/

Kennedy, A. (2016). Functions of a Database Management System. Functions of a DBMS A DBMS performs several important functions that guarantee the integrity and consistency. Retrieved from http://slideplayer.com/slide/7051309/

Keywordsuggest. (2017). Image Gallery: Human factors psychology. Retrieved from http://keywordsuggest.org/gallery/100005.html

Knight, R. (2015). Convincing Skeptical Employees to Adopt New Technology. Retrieved from https://hbr.org/2015/03/convincing-skeptical-employees-to-adopt-new-technology

Lawson, E., & Price, C. (2003). The psychology of change management.

Leadership, T. I. f. S. (2017). Basic principles of systems thinking as applied to management and leadership.

Lientz, B. P., & Rea, K. P. (2004). Chapter 15 - Implement New Technology and Systems *Breakthrough IT Change Management* (pp. 253-267). Boston: Butterworth-Heinemann.

LLP, X. T. (2017). Data Lifecycle Management. Retrieved from http://www.xpedivent.com/datamgmt.php

Logframer. (2017). The Project Cycle. Retrieved from http://www.logframer.eu/content/programming

Madsen, S. (2014). Overcoming Resistance to Change. Retrieved from http://www.susannemadsen.co.uk/blog/overcoming-resistance-to-change

Malik, M., & Patel, T. (2016). DATABASE SECURITY - ATTACKS AND CONTROL METHODS. *International Journal of Information Sciences and Techniques (IJIST), Vol.6*(No.1/2), 175-183.

MANAGEMENT, U. S. O. O. P. (2017). Performance Management

PERFORMANCE MANAGEMENT CYCLE. Retrieved from https://www.opm.gov/policy-data-oversight/performance-management/performance-management-cycle/monitoring/feedback-is-critical-to-improving-performance/

McDonald, D. D. (2017). *10 Basic Suggestions for Planning and Managing Data Intensive Projects*. Retrieved from http://www.ddmcd.com/managing-technology/10-basic-suggestions-for-planning-and-managing-data-intensiv.html

Medland, T., & Fletcher, M. (2016). *The STFC Project Management Framework*

Retrieved from Science & Trchnology Facilities Council:

Mishra, B. K., Hazra, D., Tarannum, K., & Kumar, M. (2016, 25-27 Nov. 2016). *Business Intelligence using Data Mining techniques and Business Analytics.* Paper presented at the 2016 International Conference System Modeling & Advancement in Research Trends (SMART).

MITRE. (2017). Risk Mitigation Planning, Implementation, and Progress Monitoring. Retrieved from https://www.mitre.org/publications/systems-engineering-guide/acquisition-systems-engineering/risk-management/risk-mitigation-planning-implementation-and-progress-monitoring

Nadkarni, A., & DuBois, L. (2014). *Enterprise Data Lake Platforms: Deep Storage for Big Data and Analytics*. In IDC (Series Ed.) Retrieved from https://australia.emc.com/campaign/global/digitalforum2014/2014-IDC-Enterpise-Data-Lake-Platforms-Deep-Storage-for-Big-Data.pdf

O'Sullivan, & Sheffrin, S. M. (2003). *Economics. Principles in action*. Needham: Mass.: Prentice Hall.

Online, H. U. (2016). What Is The Software Development Life Cycle? Retrieved from http://techdissected.com/editorials-and-discussions/what-is-the-software-development-life-cycle/

Oracle. (2011). *Successful Data Migration* Retrieved from http://www.oracle.com/technetwork/middleware/oedq/successful-data-migration-wp-1555708.pdf

Patil, A., & Meshram, P. B. B. (2012). Database Access Control Policies. *International Journal of Engineering Research and Applications (IJERA), Vol. 2*(Issue 3), 3150-3154.

ProProfs. (2017). Basic Computer Skills Assessment. Retrieved from http://www.proprofs.com/quiz-school/story.php?title=basic-computer-skills-assessment

Rouse, M. (2015). database management system (DBMS). Retrieved from http://searchsqlserver.techtarget.com/definition/database-management-system

Ruan, R., Deng, M., & Wang, C. (2016, 27-29 July 2016). *Implementation of a flexible and extensible clinical data management system for cardiovascular disease.* Paper presented at the 2016 35th Chinese Control Conference (CCC).

Services, D. o. F. a. (2013). *Transition Guidelines: Managing legacy data and information* Vol. V.01. N. GOVERNMENT (Ed.) Retrieved from https://www.finance.nsw.gov.au/ict/sites/default/files/Transition%20guidelines%20FINAL%2014NOV2013.pdf

Simmerman, D. S. (2011). *Motivation? It is feedback, not extrinsic motivators, the drive performance*. Retrieved from http://performancemanagementcompanyblog.com/2011/12/05/motivation-it-is-feedback-not-extrinsic-motivators-the-drive-performance/

Sinha, R. (2014). How To Deal With Resistance To Change In The Workplace? Retrieved from https://www.linkedin.com/pulse/20140717111252-169955770-resistance-to-change-how-to-counter-it-at-workplace

Sirianni, A. (2017). *The Importance of Data and Information in Business*. Retrieved from https://www.dcode.com.au/blog/the-importance-of-data-and-information-in-business

Sundareswaran, R. (2013). A seven-step data migration methodology for insurers. Retrieved from http://www.insurancetekinsights.com/bi/a-seven-step-data-migration-methodology-for-insurers/

Tank, P. (2017). Data Processing Cycle. Retrieved from http://planningtank.com/computer-applications/data-processing-cycle

techopedia. (2017). Data Management Software (DMS). Retrieved from https://www.techopedia.com/definition/11363/data-management-software-dms

Teknimedia. (2017). Total TekAssess Digital Skills Assessment. Retrieved from https://www.teknimedia.com/html/digital-skills-assessment.html

Tierstein, L. M., Systems, W. R., & Ltd. *A Methodology for Data Cleansing and Conversion*. Retrieved from https://www.scribd.com/document/42611742/Data-Conversion-and-Cleansing-Methodology

UniversityAmsterdamVU. (2017). Research Data Essentials: Data life cycle. Retrieved from http://libguides.vu.nl/c.php?g=527520&p=4054390

Wack, P. (1985). Scenarios: uncharted waters ahead. *Harvard Business Review, 63*(5), 73-89.

Wikipedia. (2017a). Emotional intelligence. Retrieved from https://en.wikipedia.org/wiki/Emotional_intelligence

Wikipedia. (2017b). Geographic information system. Retrieved from https://en.wikipedia.org/wiki/Geographic_information_system

Wulf, P. D. T., Meissner, P., & Stubner, D. S. (2010). *A Scenario-based Approach to Strategic Planning – Integrating Planning and Process Perspective of Strategy* In H. L. G. S. o. Management & C. f. S. P. R. B. R. Unit (Series Eds.), W. P. 1/2010 (Ed.) Retrieved from http://www.hhl.de/fileadmin/texte/publikationen/arbeitspapiere/hhlap0098.pdf