TÉCNICO LISBOA

Finding Maturity Evolution Paths for Organisational use of Information

A *Moviflor* Case Study

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Abstract

Exploiting the full potential of information by adequately accessing, processing and using it as needed – thus providing the ability to enable strategic information to be derived from operational data – is a crucial but challenging ability for Organisations, given their growing capacity of easily capturing and storing high volumes of data. Modern Organisations need to aspire to an accurate and adequate use of Information, if they want to enable their teams to make well-informed business decisions.

Building upon the concepts of Business Intelligence, Business Maturity, Enterprise Modelling and Business Transformation, the goal of this thesis is to provide engineering methods to construct a design model able to describe evolution paths of Organisations' maturity regarding their actors' use of information, eventually culminating in Business Intelligence.

In order to reach the established thesis goal, the research relevance and applicability is continuously assessed trough the proximity with real-world organisational environment. This proximity allows for developing a solution, constantly keeping in mind Organisational complexity and unique characteristics.

To solve the proposed goal, always keeping a foot in the Organisational context, this thesis proposes a bottom-up approach to assess Organisational Maturity in daily use of information and define related maturity evolution paths, by abstracting enterprise complexity.

The proposed models aim at providing a more detailed awareness on how Organisations have to pilot trough their evolution paths, progressively and adequately gaining capacities and maturity in information use, by evolving the maturity of people, IT and processes.

Keywords: Information Use, Business Maturity, Enterprise Modelling, Business Transformation

Resumo

Para que seja possível retirar o máximo potencial de toda a informação presente numa Organização, é necessário desenvolver os mecanismos que possibilitem um correcto acesso, processamento e uso dos seus dados, permitindo assim a extracção de informação estratégica a partir de dados operacionais. Esta capacidade é fundamental para as Organizações modernas, ainda que constitua um grande desafio considerando o crescente volume de dados capturados e armazenados diariamente. As Empresas modernas terão de optimizar o seu uso de informação para que seja adequado à realidade operacional, permitindo assim tomadas de decisão fundamentadas e devidamente informadas.

O objectivo da presente investigação é de desenvolver métodos de engenharia adequados ao desenho de caminhos de evolução na maturidade de uma Organização no seu uso de Informação, indo culminar no *Business Intelligence*.

Através de toda a investigação, foi mantida a proximidade com a realidade empresarial, caracterizada pela sua complexidade e características únicas, garantindo assim a aplicabilidade e relevância da solução desenhada.

Para que fosse possível atingir o objectivo estabelecido, foi aplicada uma abordagem “Bottom-Up” que permite avaliar o estado de maturidade de uma Organização no seu uso de informação e, de seguida, delinear possíveis caminhos de evolução, reduzindo significativamente a complexidade inerente a um estudo desta natureza numa Empresa real.

O modelo proposto visa permitir uma maior consciência organizacional bem como uma melhor visão de como uma empresa deve percorrer os seus caminhos de evolução de maturidade, optimizando progressivamente os seus processos e Tecnologias de Informação, e ganhando maturidade nas suas mais variadas competências.

Palavras-Chave: Uso de Informação, Maturidade Empresarial, Modelação Empresarial, Transformação Empresarial

Preface

The present research took place along two iterations – two Design Science Research Loops –, as further described in Section 1.2 “Research Methodology”.

The primary thesis problem arose from an initial motivation that was altered when the first contact with the Organisation under study took place. This confrontation with reality altered the initial research context and required for the investigation to be rethought.

So, after an initial iteration in the Organisation, it was clear that the initially stated problem was actually not the real problem that the Organisation needed to solve. This experience implied for a thesis repositioning towards the resolution of this newly defined context.

Hence arose the need for a second iteration at the Organisation, with previous acquisition of more knowledge on the new subjects under study, to enable an accurate definition of a new thesis problem.

The whole experience throughout those two Design Science Research cycles is reported along this research and was of high importance for this thesis evolution as well as an enriching experience both at educational and personal levels.

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Acronyms

AR	Action Research
BI	Business Intelligence
DSR	Design Science Research
DSRM	Design Science Research Methodology
EM	Enterprise Modelling
ERP	Enterprise Resource Planning
IS	Information Systems
IT	Information Technology
MM	Maturity Model
OSA	Organisational Self-Awareness

1 Introduction

Current Information Technology and Information Systems enable Organisations to store huge amounts of information about their activity, thus empowering employees by allowing them to access and use those information assets to perform their daily activities [1].

This recent capacity of easily capturing and storing high volumes of information can be of great advantage to Organisations if effectively managed, but can bring equally great harms if not. In fact, and contrary to the behaviour of other assets, having more information do not necessarily bring greater value [2].

It is thus critical for Organisations to know whether their stored information is useful or useless, since the reliability of the information will profoundly affect decision-making processes throughout the Organisation [3].

In order to do so, Organisations first need to learn how to use and manage information intelligently, so as to act more efficiently and effectively and thus create value for its daily business. Intelligent Information Management is the key to get information's full potential by adequately accessing, processing and using it as needed, thus providing the ability of enabling for strategic information to be derived from operational data.

Beyond Organisations capability of Information Management, they need to be able to view and treat information as a strategic resource, like any other critical organisational resource, thereby valorising it. Information in fact consists of data that has been given context and endowed with meaning and significance, and can be subsequently transformed into knowledge through reasoning and reflection into beliefs, concepts, and mental models [4]. This strategic resource can be extremely powerful if correctly converted into organisational knowledge.

In order to do so, Organisations need to aspire to an accurate and adequate use of their Information, enabling for them to accomplish tasks more accurately and operate more competitively, thus enhancing business performance. This aspiration is also crucial in order to enable Organisations to achieve their business goals and follow overall strategy.

Correct Information Management and use in an Organisation is the foundation for it to prosper, and will ultimately lead to Information and Business Intelligence.

A successful Business Intelligence solution is the ultimate tool to the success of an Organisation. It enables organisations to make well-informed business decisions, leading to competitive advantages by supporting processes and best practices, and empowering employees to ignite the power of the entire organisation.

However, the implementation of such a solution without previously understanding how the entire Organisation works could have negative effects on a business. It is thus crucial for Organisations to clearly understand where they are, in order to realise where they need to be.

1.1 Thesis Motivation

The motivation for this thesis arises from *Moviflor's* need to implement a Business Intelligence system in order to achieve value creation.

Moviflor is a Portuguese company created in 1971, specialised in the retailing of furniture and home decoration. In 40 years of existence, it has gone through a lot of structural, economy and market changes. Initially managed as a family-type company, it has evolved to become a "giant" in the Portuguese furniture sector, having to face the entry of a big multinational competitor – IKEA – in its market in 2004.

Despite all that, *Moviflor* has always managed to keep its ground by adapting its operation, and is, as of today, the best-established company in its business area, representing the best-known brand in the sector.

Its organisational need for change emerges from the current difficult economy and from the need to optimise its operation, by getting the full potential of new technologies.

The present research will thus focus on Information Management and use in Organisations**,** by undertaking a Case Study at *Moviflor*.

Grounded on a direct interaction with the Organisation, this research aims at understanding *Moviflor's* real needs as well as the viability of a Business Intelligence system implementation, as it is intended, based on organisational reality (Organisation culture, complexity, maturity, etc.).

1.2 Research Methodology

This investigation will be conducted following a qualitative approach, defined by the use of qualitative data - like interviews, documents, and the researcher's observation data - as well as by the researcher's proximity with the studied environment.

Qualitative research methods were initially developed in the social sciences, enabling researchers to better understand people and the social and cultural contexts within which they live [5]. The proximity with the observed phenomenon allows for a direct interaction with the individuals, in order to better interpret the environment reality.

In Information Systems, qualitative research methods are often used in studies of managerial and organisational issues associated with innovations in information and communications technology. The use of this method enables to gather rich, detailed and reliable information from multiple sources, like participant observation (fieldwork), interviews and questionnaires, documents and texts, and the researcher's impressions and reactions [5]. All of this allows for a better understanding of well-defined and specific phenomenon observed in the real world.

The qualitative research method where the present research takes its roots is the Action Research (AR) Method, which associates theory and practice - thinking and doing - aiming to achieve practical and research objectives [6], and is said to be "ideally suited to the study of technology in its human context" [7]. This method thus seems to be very appropriate for research in the Information Systems discipline, producing extremely relevant research findings by merging research and praxis [7].

The Action Research approach consists of a five-step cyclical process which requires a previously established research environment here called “Client System” infrastructure [8]. Those five phases are Diagnosing, Action Planning, Action Taking, Evaluating, and Specifying Learning, creating the AR Cycle outlined in Figure 1.

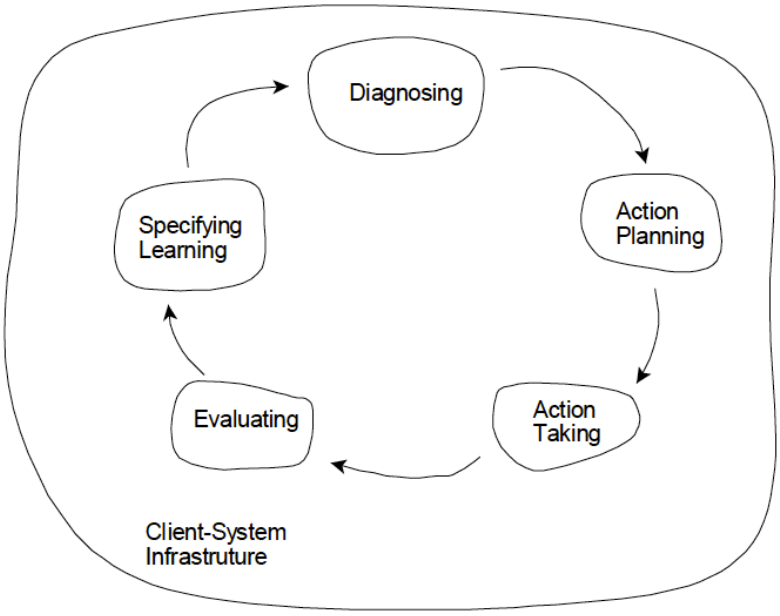

Figure 1 – The Action Research Cycle [8]

Although the present Research has some components of Action Research, as it takes place in a previously established research environment at *Moviflor* (as described in Section 1.) and is based on qualitative data and a close interaction with de individuals being studied, the need of a greater focus on engineering methods for the design of the artefact was felt.

Hence the use of the Design Science Research Method, compatible with the AR approach, as its purpose is to *“extend the boundaries of human and organizational capabilities by creating new and innovative artefacts”* [9]

Whilst both approaches may differ in their paradigmatic assumptions, research interests, and activities, for the purpose of this research their combination seems to be quite valuable [10].

Design Science Research

"Design Science Research (DSR) is motivated by the desire to improve the environment by the introduction of new and innovative artefacts and the processes for building these artefacts." [11]

DSR brings a wider understanding to the field of IS Research, seeing Information Systems mainly as social systems of which IT is only one aspect, Organisation and People being the two complementary and equally important aspects.

Much of the research in the Information Systems discipline is characterized by two paradigms: the behavioural science paradigm, which seeks to develop and verify theories that explain or predict human or organizational behaviour, and the design-science paradigm, which seeks to extend the boundaries of human and organizational capabilities by creating new and innovative artefacts [9]. As the IS discipline is positioned at the confluence of **people**, **organizations**, and **technology**, both paradigms are essential: the goal is thus to develop knowledge concerning both the management of information technology and the use of information technology for organizational purposes, through the design and application of a solution.

In that perspective, *Hevner* [12] included those complementary approaches in his vision of DSR as an embodiment of three closely related cycles of activities, as seen in Figure 2, that must be present and clearly identified in a DSR project.

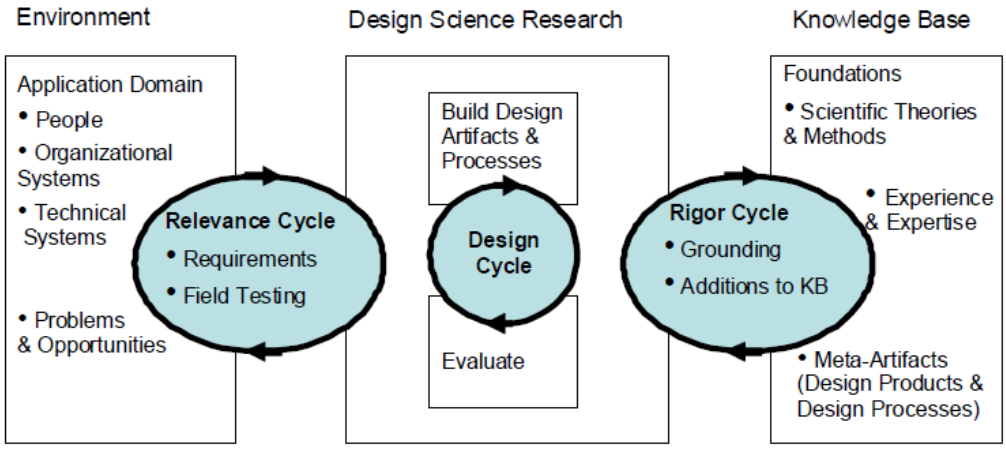

Figure 2 - Design Science Research Cycles [12]

The Relevance Cycle

The Relevance Cycle bridges the contextual environment of the research project with the design science activities. The researcher must question whether the design artefact will improve the environment and how this improvement may be measured.

The research context provides inputs for the investigation requirements (e.g., the opportunity/problem to be addressed) and defines acceptance criteria for the ultimate evaluation of the research results. The output from the DSR must be returned into the environment for study and evaluation in the application domain, as designing artefacts both needs and creates knowledge.

Posterior field-testing will determine whether additional iterations of the relevance cycle are needed in the DSR project. If it is, another iteration of the relevance cycle will begin with feedback from the environment from field-testing and a restatement of the research requirements as discovered from the previous experience.

As previously stated, the field-testing of the artefact can be executed by means of appropriate technology transfer methods such as Action Research [13].

The Design Cycle

The central Design Cycle is the heart of any DSR project, and iterates between the core activities of building and evaluating the design artefacts and processes of the research. It is where the hard work of DSR is done. The research must produce a viable artefact in the form of a construct, a model, a method, or an instantiation.

DSR aims at providing generic and innovative artefacts, solving a class of unsolved and relevant problems – and not only a singular one –. Designed artefacts are adaptable solutions to those problems, as opposed to classic “one-size-fits-it-all” solutions.

The design requirements are input from the relevance cycle, and the design and evaluation theories and methods are drawn from the rigor cycle.

During the performance of the design cycle it is important to maintain a balance between the efforts spent in constructing and evaluating the evolving design artefact.

The Rigor Cycle

Innovations created by DSR *relies on existing kernel theories that are applied, tested, modified, and extended through the experience, creativity, intuition, and problem solving capabilities of the researcher [14].*

The Rigor Cycle connects the design science activities with the knowledge base of scientific foundations, experience, and expertise that informs the research project. It provides past knowledge to the research project to ensure its innovation.

Design science draws from a vast knowledge base of scientific theories and engineering methods and expertise that defines the state-of-the-art in the application domain of the research, which provide the foundations for rigorous DSR.

Research rigor in design science is predicated on the researcher’s skilled selection and application of the appropriate theories and methods for constructing and evaluating the artefact.

Effective DSR must provide clear and verifiable contributions in the areas of the design artefact, like extensions to the original theories and methods, the new meta-artefacts (design products and processes), and all experiences gained from performing the research and field-testing the artefact in the application environment.

Design Science Research Methodology Process Model

In order to provide a commonly accepted framework for successfully carrying out DSR, *Peffers et al*. [15] proposed and developed a Design Science Research Methodology (DSRM) for the production and presentation of DSR in Information Systems. This methodology will be the basis for the present research, and is depicted in Figure 3.

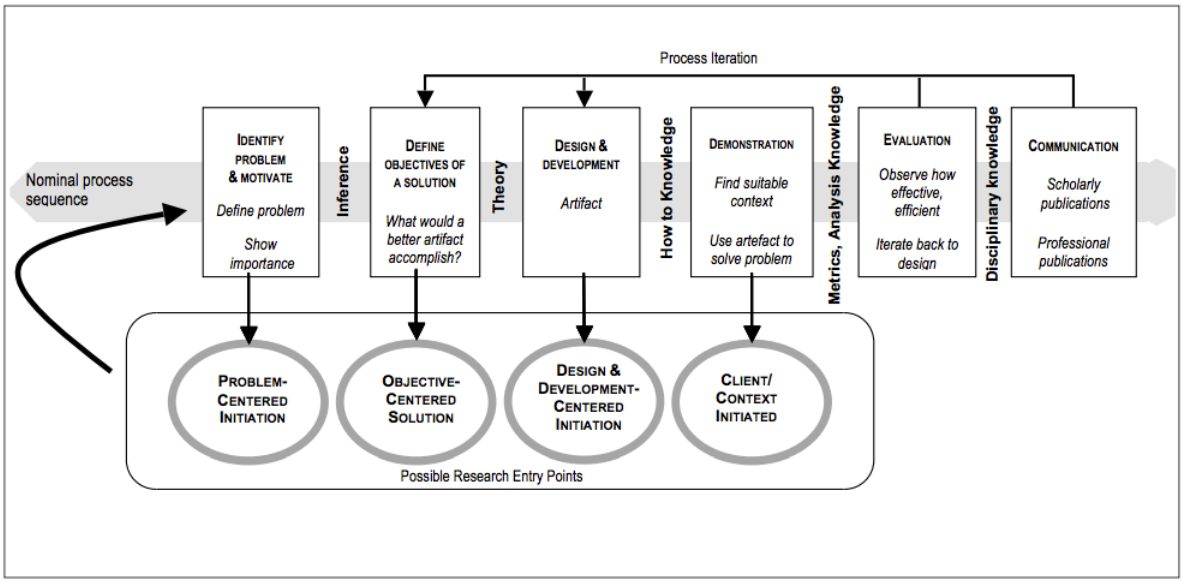

Figure 3 - Design Science Research Methodology Process Model [15]

Activity 1: Problem identification and motivation

Define the specific research problem and justify the value of a solution.

Activity 2: Define the objectives for a solution

Infer the objectives of a solution from the problem definition and knowledge of what is possible and feasible.

Activity 3: Design and development

Create the artefact. Such artefacts are potentially constructs, models, methods, or instantiations (each defined broadly); but are rarely full-grown information systems that are used in practice [9].

Activity 4: Demonstration

Demonstrate the use of the artefact to solve one or more instances of the problem. This could involve its use in experimentation, simulation, case study, proof, or other appropriate activities.

Activity 5: Evaluation

Observe and measure how well the artefact supports a solution to the problem. This activity involves comparing the objectives of a solution to actual observed results from use of the artefact in the demonstration.

Activity 6: Communication

Communicate the problem and its importance, the artefact, its utility and novelty, the rigor of its design, and its effectiveness to researchers and other relevant audiences.

The proposed process is structured in a sequential order. However, there is no expectation that researchers would always proceed in sequential order from activity one through activity six. In reality, they may actually start at almost any step and move outward [15].

DSRM is typically as an iterative process, as each cycle uses knowledge in order to increase problem awareness and to create new knowledge that is later added to the knowledge base.

1.3 Outline

Drawing Parallels

The previously mentioned Design Science Research activities (See Figure 3) can be compared and aligned with the Action Research Steps (see Figure 1), and consequently aligned with the present research structure.

The outline of this document will thus be structured by following the two DSR Loops that guide the entire research, as follows:

First Design Science Research Loop

1. Identify Problem & Motivate – AR "Diagnosing"

   1.1 Thesis Motivation 2 Conceptual Foundation

2. Define Objectives of a Solution – AR "Action Planning"

   3 Thesis Problem

3. Design & Development – AR "Action Taking"

   4.1 *Moviflor* 'AS IS' 4.2 *Moviflor* 'TO BE'

4. Demonstration – AR "Evaluating"
5. Evaluation – AR "Evaluating"

   4.3 Conclusions

6. Communication – AR "Specifying Learning"

   4.4 Lessons Learned

Second Design Science Research Loop

1. Identify Problem & Motivate – AR "Diagnosing"

   4.4 Lessons Learned 5 Extending the Knowledge Base

2. Define Objectives of a Solution – AR "Action Planning"

   6 Thesis Evolution

3. Design & Development – AR "Action Taking"

   7.1 Solution Domain 7.2 Back to *Moviflor* 7.3 Solution Design

4. Demonstration – AR "Evaluating"
5. Evaluation – AR "Evaluating"

   7.4 Validation

6. Communication – AR "Specifying Learning"

   8 Conclusions and Future Work

The research structure and alignment with previously described concepts is further depicted Figure 4.

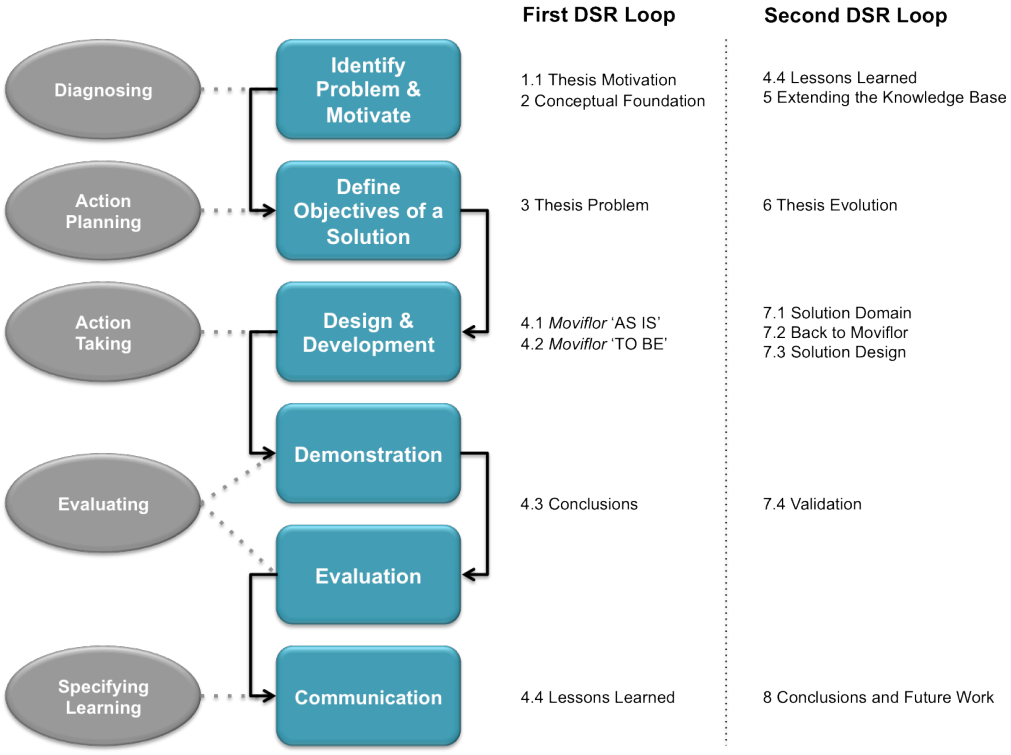

Figure 4 - Research structure

I - First Design Science Research Loop

"Intelligence is not the ability to store information, but to know where to find it."

Albert Einstein

2 Conceptual Foundation

2.1 Business Value

Over the past few decades, the notion of value in the business scene has ceased to be seen only on a pure financial perspective, in which value is created when revenue earned from business exceeds expenses. Organisations began to recognize that the concept of business value goes beyond economic value, as it is proven to be a better management goal than mere financial measures of performance. However, the growing change in Organisational information and knowledge has been posing significant challenges to the creation of business value [16].

Peter Drucker, leader creator of Management as a formal discipline, stated Business as an Organisation that *"adds value and creates wealth"* and that *"There is only one valid definition of business purpose: to create a customer."* Hence, as value is created for customers, wealth is generated for owners. [17]

Organisations first focus should thus be on customers, and on how to create business value for them, setting value creation as the first priority for all employees and all corporate decisions.

Value Creation

Yet, creating value for the customer cannot be achieved by itself. In order to create sustainable value, all stakeholders need to be taken into account, as their interests are intimately linked. Understanding customer, as well as employee and investor needs is the key to achieve such task, as sustainable value cannot be created for one group unless it is created for all of them. [18]

The continuous process of creating value throughout the Organisation is further depicted in Figure 5.

Understanding unique customer needs, rapidly and with precision, is essential to create useful goods and services through product and process innovation. Customer value creation can also be achieved by the employee's commitment, energy and imagination to provide outstanding service.

For that to happen, employees must be treated respectfully and feel that they are involved in decision-making. Meaningful work, good compensation, continued training and personal development are also critical factors for bringing employee value creation.

For the investors, value can be brought by the consistent delivery of high returns on their capital, strong revenue growth and attractive profit margins. Those factors are only achievable if the organisation is able to deliver sustained value for customers… And so on.

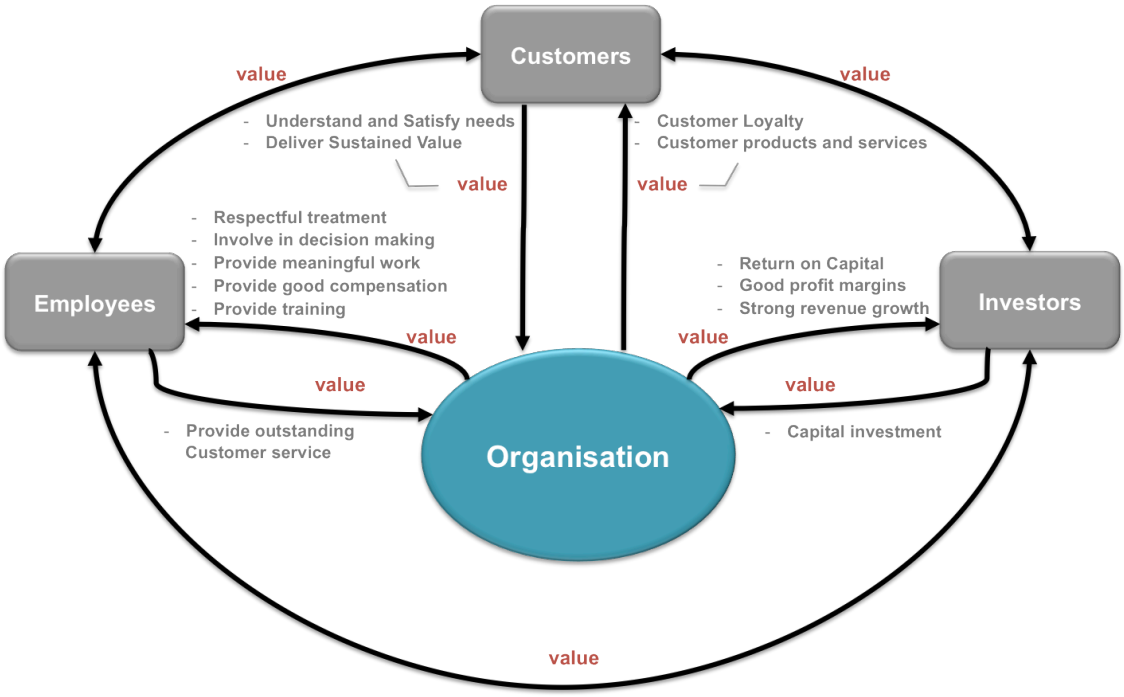

Figure 5 - Value Creation Cycle

Some additional factors that influence value creation include technology, intellectual property, alliances, management capabilities, employee relations, customer relations, community relations, and brand value. However, these intangible and non-financial aspects are difficult to quantify, being thus often disregarded by Corporate Governance as important factors that bring value creation [19].

It has been proven that putting growth or size first without understanding the notion of value or the value construction methods can drive an organisation to failure. Although those tasks are not simple to achieve, some conclusions can be drawn from the methods used by dominant and fast growing businesses:

> By identifying which activities and assets are fundamental for sustainable and profitable growth, Organisations get a deeper understanding of how and why value is created within a company and a market. This enables them to understand how and where to grow.

Overall, focusing business on value creation will ultimately give organisations some sustainable and grounded advantages over the competitors, like the constant production of Business Capital and Talent [20].

2.2 Business Intelligence

Business Intelligence (BI) can be defined as "a set of technologies that allow the acquisition and analysis of data to improve firm decision-making and workflows" [21], therefore seen as a system integrating knowledge management and decision support processes. However, there is a lot more to BI than simple accumulation and exploration of data.

In today's information society, with the proliferation of on-line databases, the massive diffusion of enormous amounts of information and the easy access to it, the key to BI is to generate intelligent information. That is reliable and relevant information, which can be put to use to get hold of the strategic objectives of the organization, if possible in a cost-effective way.

In that perspective, A. Martin [22] states a much more accurate definition:

"Business intelligence is the process of gathering enough of the right information in the right manner at the right time, and delivering the right results to the right people for decision-making purposes, so that it can continue to yield real business benefits, or have a positive impact on business strategy, tactics, and operations in the enterprises."

Business Intelligence has recently been denominated as top business priority instead of being a top technology priority in previous years [23], and is now commonly regarded as a strategic capability for most organizations when it comes to creating, collecting, analysing and applying information and knowledge.

In that way, the strategic positioning of a company can be supported by managerial decision to implement BI in order to transform the available data from the environment to useful information for decision-making across a broad range of business activities.

Information Intelligence

Information intelligence can be defined as the ability to successfully search, assemble all pieces, analyse, and effectively use all relevant available information for any decision and initiative. In order to become information intelligent, it is therefore essential that Organisations learn how to use their information resources successfully [24].

As the amount of data in organizations increases, this ability will become increasingly important whilst becoming more and more difficult to achieve.

The search for intelligent information is a complex and endless process, since a successful organisation must be ever changing, constantly learning and improving. As such, this process is dynamic and iterative and its implementation will come with associated costs and challenges [24].

Business Intelligence Systems

As stated by *Gilad and Gilad* [25], "There is more to Business Intelligence than the mere accumulation of data".

Although a highly effective tool for improving organizational performance, the implementation of a Business Intelligence system reveals itself to be an extremely complex and difficult process [26]. This complexity can come from several causes, such as employee resistance, management related issues

or lack of clear definition of accountability and responsibility. Still, leadership as consistently been identified as the most important factor affecting IT systems implementation [27].

Studies have shown that the growing need for BI in Organisations doesn't come from the search for new sources of data but from the Managers concern in finding as a strategic tool to reduce the constant flood of data into a manageable amount of reliable and useful information for decision-making.

In order to do so, the implementation of an effective BI system is required. That is a system tailored to the organisation, and able to fit the particular goals and needs of the company, as to become an organic part of the organisation.

The major difficulty to overcome when implementing such a system is probably to create a structure that provides optimal output and distribution of intelligence for proper decision-making, considering that "all the intelligence in the world is useless if it does not reach the right users at the right time". [25]

In order to do so, it is best to follow a "need-to-know" approach, by determining who needs to get what information, when and how, as opposed to a "want-to-know" philosophy, in which the tendency is to create an overload of unnecessary information and reports.

A Business Intelligence system can thus be a powerful and effective strategic tool to "convert raw data to useful intelligence by setting targets and priorities and developing procedures for the evaluation, storage, and dissemination of information." [25]

Nevertheless, in order to play a role as a strategic tool as intended, BI implementation process should follow closely the strategic planning of the firm [25], so as to later provide relevant input to the strategic plans of the firm in return.

2.3 Enterprise Engineering

"Enterprise Engineering aims to comprehend enterprise complexity – and thereby master it –and can be seen as a developing discipline - domain of knowledge, concepts, theory and associated methodology – for analysing, designing and creating enterprises." [28]

The main goal of Organisations is to pursue value creation for their business, which can be achieved by the implementation of a strategic plan. For that to happen, organisations need to understand where they are and where they have to go, if they want to take effective and adequate measures. However, more often than not, the strategic initiatives taken fail, mostly because they turn out to be inadequate.

J.Hoogervorst claims that the "Core reason for strategic failures is the lack of coherence and consistency among the various components of an enterprise" [28]. For that coherence to take place, enterprises must be seen as social systems, purposefully designed and engineered. This represents the new point of view to organisations brought by the discipline of Enterprise Engineering.

Over the last few years, researchers in this area have drawn a distinction between form and content of information, thus evolving from the "automated work" to an "informed work" performed by the organisational actors.

These new insights brought a new notion of commitment from social actors. The intention of information is now placed above its content, and the various responsibilities, qualifications and authorizations associated with the actor's commitments become clear [28].

Enterprise Engineering is closely linked with Information Technology utilisation in the organisational environment, as it enabled for an informed work. We have thereby a transition from the era of "Information Systems Engineering" towards the era of "Enterprise Engineering" [28].

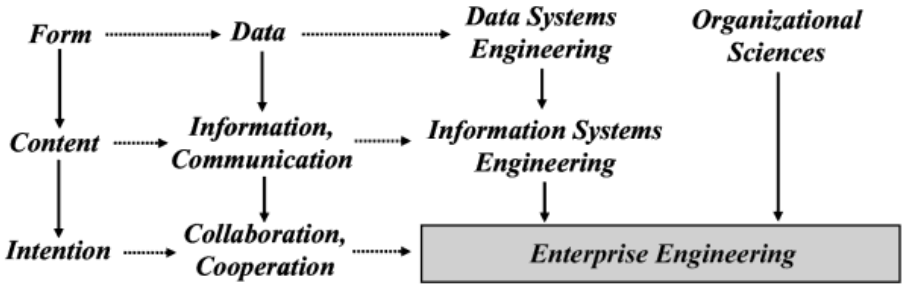

Figure 6 - The roots of Enterprise Engineering [28]

These evolutions give a new perspective on Enterprise Management, focusing not only on WHAT organisations must accomplish to obtain value creation, but also on HOW they should do it.

Hence, Enterprise Engineering addresses not only operational aspects regarding the production of products and services, but the ability of the enterprises to address future and unknown developments successfully too: Enterprise Engineering empowers enterprise change and adaptation [28].

In today's ever-changing and unpredictable competitive environment, Enterprise Engineering constitutes an effective approach for implementing strategic organisational initiatives successfully, by addressing a fundamental question: "How to design and improve all elements associated with the total enterprise, through the use of Engineering and analysis methods and tools to more effectively achieve its goals and objectives". [29]

3 Thesis Problem

3.1 Problem Statement

In over 40 years of activity in the Portuguese furniture and home décor retail sector, *Moviflor* has accumulated important knowledge on how to lead business in the national market, but its significant growth over the years also implied for them to have to deal with some complex issues. *Moviflor* was initially structured and adapted to one specific management reality, running as a small family-type business with only a few shops to manage. Over the years, this reality has steadily evolved and the number of shops increased substantially, forming what is today a big network of shops, warehouses, distribution centres and even one outlet shop. This structural evolution profoundly changed the business and *Moviflor* had to be reorganized in order to adapt to its new setting.

Dealing with all the necessary processes to manage such a big company is not an easy task, and *Moviflor* still has some troubles keeping up with the fast changing reality of modern markets and technologies.

A first superficial analysis of *Moviflor* present reality showed inadequate processes, unsuited Information Technology tools and use, deficient Corporate and IT Governance methods, as well as a lack of methods to support decision making. Furthermore, the organisation presents a profound need to acquire methods in order to deal with Information Management, as there are lots of available data accumulated throughout the years – like customer purchases and decision making processes, the competition, conditions in the industry and economy, technological and cultural trends –.

Yet, Moviflor has no implemented system capable of addressing the necessary data cleaning, analysis and storage, as well as the subsequent transmission of intelligence – in the right form and at the right time – to the appropriate decision makers.

In order to deal with all those issues, a rigorous analysis of the Organisation and subsequent scientific study must be undertaken, in order to provide *Moviflor* with robust and suitable methods to implement a Business Intelligence solution, allowing it to become a dynamic and competitive company, better prepared to face constant challenges.

3.2 Research Objectives and Contributions

The primary goal of this research is the design of a model that supports Business Intelligence implementation at the Portuguese company Moviflor. This model will consist of a scientific method replicable in other organisations, which will be instantiated at Moviflor to fit the organisation's needs.

In order to do so, some issues will be addressed by answering questions that must be asked, such as:

- What are the essential Organisational requirements to a correct implementation of Business Intelligence?
- How should Business Intelligence be used, and by whom?
- How should Business Intelligence be inserted at the several Organisational levels?

- What Organisational aspects or areas will the implementation of Business Intelligence affect?
- What is the meaning of “value” for the Organisation?
- How is value created in the Organisation?
- How is Business Intelligence ultimately going to add value to the Organisation?

Having addressed all those aspects, we will be able to design the framework of methods that is the core purpose of this thesis by establishing a clear and scientifically robust methodology to deal with Organisational reality, and following an Enterprise Engineering approach.

4 Moviflor Case Study

Performing this research in a real organisation trough a case study allows putting into practice the previously studied concepts and theories, in order to validate their applicability in real life situations.

Work done at *Moviflor*

In a preliminary phase, crucial information concerning the Organisation was gathered and fully analysed, such as data about its structure, history, market share, products and services, sales channels, marketing campaigns and communication, positioning, as well as information about *Moviflor* strategy like its mission, vision, differentiation methods, strategic objectives, etc. This step was essential in order to bring some understanding about the Organisation origins, culture, and target audience, as well as to assess Organisational maturity.

The next phase consisted of field observation in stores (different in size, positioning and oldness), warehouses, distribution centres, the contact centre and the headquarters; as well as interviews with crucial member of *Moviflor* staff at each one of those places. This observational and interviews phase allowed to understand overall processes throughout the Organisation.

Finally, a full round of interviews with the heads of *Moviflor* main departments took place (Operations, Purchasing, Marketing, and Information Systems Departments). The main goal of those interviews was to understand the current situation of the Organisation (‘AS-IS’ Model) regarding the available information and its use in daily actions, as well as information lacks and needs in order to ultimately capture real Business Intelligence needs.

Details about the interviews undertaken at *Moviflor* can be found in Appendix A – Interviews and Survey Methodology.

4.1 *Moviflor* 'AS IS'

After several iterations at *Moviflor* throughout the previously mentioned phases, the current Organisational situation, or 'AS-IS' model, is described as follows.

Moviflor structure respects a functional structure, leaded by a CEO that is under direct orders of a one-person Board of Directors (the founder). As previously mentioned, the company has greatly evolved in its 40 years of existence, reaching a stable operational activity and constantly keeping up with market evolution.

There is thus a strong experience and knowledge on how to lead business, how processes are executed on daily operational activity, and on the services and systems that support organisational activity.

Information Systems Architecture is well defined and revolves around a centralized Enterprise Resource Planning (ERP) system - "SAP R/3"- where all Organisational data is stored. The system provides a robust Information Architecture by defining and structuring coherent informational entities, and enables a good information maturity level by guaranteeing centralized, consistent and reliable data. Additionally, the ERP system has a built-in function that provides statistical information about operational execution.

Nevertheless, business processes are still on a low maturity level, as there is no overall awareness and recognition of standard processes, information flows thereto associated and business actors' information usage. This structured vision of sequential business activities into business processes is only partially present at management level in the Purchasing Department.

Interviews at different hierarchical levels and in different functional departments revealed that business actors have a poor notion of how their activities are inserted in the Organisation and no vision of how their actions are related to – and impact on – overall business processes.

This general lack of a structured vision makes it difficult to understand business actors information needs, though it is clear that information granularity varies in distinct hierarchical levels – actions at lower levels require more specific information, whereas higher hierarchical levels require aggregated information –.

In addition to the information provided by the ERP system, Managers from different departments have access to monthly execution reports on their departments' activity in order to have a grasp on operational reality. Those reports consist of manually extracted and compiled data, generated through a long and arduous *ad hoc* process.

4.2 *Moviflor* 'TO BE'

Throughout the interviews phase, a series of questions was asked in order to capture the interviewees' information needs, to ultimately analyse and define the Organisations Business Intelligence requirements – projecting individuals' ideal 'TO BE' organisational model –. The inquiry was conducted among experienced managers from the aforementioned business areas, which have a broader vision of the organisation and a better understanding on how daily processes can be improved thanks to the Business Intelligence implementation under study.

The questions asked revolved mainly around what information was required by each interviewee in order for them to make informed and coherent decisions, and to ultimately act efficiently and effectively.

All the interviewees had the same answer tendency as to what additional information they needed in order to act: it was unanimous that all the possibly relevant ant useful data for them already exists in the "SAP R/3" ERP System database. This enormous amount of data is known to have an "incredible potential" but does not currently have an adequate extraction and processing method.

In short, it was unanimous that the biggest information lack in all business areas was not to have timely and structured information, correctly and adequately presented, and able to fit particular business actor needs.

Besides this shared vision and awareness that essential information was already being collected at *Moviflor*, the interviewees' requirements as to what tools and presentation methods would configure their ideal "Business Intelligence" turned out to be quite diverse.

Those requirements vary from basic reports presenting "information on campaigns, sales and shelf exposure to enable correct analysis" (Marketing Dept.), to "data warehousing tools enabling to process and adapt information to individual realities" (Purchasing Dept.), or more generic needs like "tools to analyse historical information, run time information and essentially to predict the future organisation trends" (Operations Dept.)

More experienced interviewees on BI implementation showed a more mature vision on what tools and methods would improve overall organisational decision-making. Online and Offline Reports, *Ad Hoc* Reports, predictive analysis allowing for trend projections, "What if" analysis allowing to explore different scenarios without effectively changing organisational variables, trend analysis and estimations where mentioned at Information Systems Department level; whereas Moviflor Project Manager brought a vision on how Business Intelligence would allow Top Management (CEO and Board of Directors) to steer Organisational strategy ("What to do next year"), predict market restrictions, project future budgets (at Department, unit or store/warehouse level), and calculate the impact of positive or negative company trends, as well as helping to produce essential financial statements.

It is thus clear that the meaning of "Business Intelligence" varies from interviewee to interviewee; some of them having more basic informational needs than others.

Nonetheless, it is also unquestionable that the basis for all those reports and analysis tools to be built upon is the same: the existing information architecture existing in the ERP system database. What must be adapted to each actor reality are the views based on raw data: how information is deployed and aggregated according to each actor's reality – everyday activities, business area or hierarchical level –.

4.3 Conclusions

Based on all the work done at Moviflor, from studying the organisational setting to the field observations, as well as the series of interviews undertaken with business actors in the most diverse areas, a series of conclusions can be drawn and are presented as follows.

Business actors don't have a common and shared vision of Organisational structure. This probably results from a lack of instruments like enterprise models and architectural views that could help providing Organisational Self-Awareness (OSA). OSA helps business actors being aware of their role in the organisation, as well as the role performed by others. Moviflor doesn't have "instruments that allow capturing and representing individual knowledge of its parts, in order to synchronize the image that they have of the whole" [30].

This causes a lack of a global vision on how business is done and its configuration of organisation-wide business processes. In fact, people on more operational levels are aware of *what* they do and *how* they do it (tasks and activities structured into processes) but not *why* they do it or the impact of their actions on the Organisation as a whole; whereas people on tactical management levels are aware of the effects of their actions and understand why undertake them (broader vision), but have no structured vision of their actions into sequences of tasks, activities and their combination into business processes ("what they do and how they do it").

Regardless of this lack of OSA, it is possible to think of Business Intelligence System implementation at Moviflor thanks to the good information maturity level provided by the "SAP R/3" ERP system which allows tracing each information entity to business activities at a basic level, providing better Information and Business Awareness.

Although, in order to reach a BI implementation that empowers Organisation and improves decision-making processes, the Organisation needs to have organisational knowledge at every level, on how the operation is lead in order to understand its exact situation, as if a picture of the Company was taken: "Where are we?". It is only based on this knowledge that it will be possible to define a strategy and to plan the future of the Organisation: "Where do we want to go?"

Moviflor analysis revealed that the basic information, necessary to act and to make informed decisions already exists in the organisation, even though it does not seem to be correctly delivered and presented to organisational actors. This way, there are no reliable inputs for them to consult, navigate and correctly process in a timely manner.

Building on those conclusions based on the reality check at Moviflor, several questions arise:

> Will a Business Intelligence system design and implementation really solve the problems that are beyond *Moviflor* felt need?
>
> Given the organisation maturity state, is it adequate to implement a BI system?
>
> Based on the interviewee's answers, throughout the organisation, is a BI system really needed, or are there other preliminary steps needed before such an implementation?

Reaching the research Design Proposal phase, the field reality check revealed it impossible to correctly answer the initially stated problem, as it seems that the real problem encountered at Moviflor is underlying the one of Business Intelligence implementation.

4.4 Lessons Learned

After the design phase of evaluation, and after having drawn the previously described conclusions, the following DSR Rigor cycle will allow grounding this research and evolve the initial problem into what will be a new Design Science Research iteration (see *Section 1.2*), in which the initial Thesis will have to be reformulated.

The initial research goal – to define essential information requirements and needs in order to accurately implement Business Intelligence tools that enable decision-making at diverse management levels at Moviflor – revealed itself to be quite a simplistic objective, being that the Organisation reality is quite different that initially expected.

It is now clear that the fundamental challenge at *Moviflor* is not the design and implementation of a technical Business Intelligence structure, but resides in finding a way to enable accurate transmission of intelligence, in the right form and at the right time, to the appropriate decision makers. The response to this new challenge will be grounded in supplementary analysis of topics like organisational maturity and information use for decision-making actions.

In order to further this research and help solving *Moviflor's* actual needs, we will now enter the second Design Science Research iteration.

II - Second Design Science Research Loop

"Once we accept our limits, we go beyond them."

Albert Einstein

5 Extending the Knowledge Base

5.1 Business Maturity

Maturity Models – or correctly maturity assessment models – are a widely accepted instrument for systematically documenting and guiding the development and transformation of organisations on the basis of best or common practices [31]. They have become an established means in the IS community to support organisations when it comes to effective management and continuous improvement for complex, multi-faceted phenomena [32].

Maturity Models are a means to support incremental development of functional domains, improving them step-by-step, by distinguishing different maturity levels that an organisation successively progresses through [33].

A Maturity Model (MM) typically consists of a sequence of maturity levels for a class of objects, where each level requires the objects on that level to achieve certain requirements [34]. When all the requirements of a level are achieved and the Organisation is stable, having reached the peak of the level where it is in, it will feel the need to evolve and will be ready to reach the next maturity level. Maturity is seen as a "measure to evaluate the capabilities of an organization" [35], while the term capability is understood as the ability to achieve a predefined goal [33].

Maturity Models are based on a set of important characteristics [34]:

Object of Maturity Assessment

MMs allow assessing the maturity of a series of different objects, like technologies, systems, processes, management, etc.

Dimensions

Specific capability areas that describe different aspects of the maturity's assessment object. Each dimension is further specified by a number of characteristics at each level.

Levels

Levels are the maturity states of the object under assessment. Each level should have a set of distinct testable characteristics.

Maturity Principle

Maturity Models can be continuous, allowing for a scoring of characteristics at different levels, or staged, requiring that all characteristics of a distinct level be achieved.

Assessment

The maturity assessment can be qualitative, by the means of interviews, or quantitative, like questionnaires with scales.

Relevant Maturity Models

The Business Information Maturity Model [36]

(Low)

Information requirement focus is on the "*what*" users would like to be delivered. The perceived data warehousing benefits centre on improved and timelier end-user access to information.

⇒ Focus on *"What"*

(Medium)

End users are no longer interested solely in *"what"* they need; they start to seek the answer to *"why"* the information is needed. Besides that, they approach information needs in terms of "*who*", "*when*" and "*where*" this information fits into the business processes that support business goals.

⇒ Focus on *"Who" (some), "What", "When"(some), "Where" (some), "Why"*

(High)

All parts of the organization are involved where information is used. The organization now tries to find *"how"* existing processes can be improved if the information is available and *"how"* information, put into business use, can best be used in business processes.

The organisation acknowledges the evolution of arbitrary and ad hoc decision processes from when information was unavailable and untimely, and that relying on individual business users is not optimal.

Decision processes that rely on individual business users are replaced with organisational decision processes that optimize the use of information throughout the organization.

⇒ Focus on *"Who", "What", "When", "Where", "Why", "How"*

Gartner's Maturity Model for Business Intelligence and Performance Management [37]

(Unaware)

"Information anarchy": inconsistent data, incorrect and inconsistent data interpretation, and constant changes. The organisation struggles to fulfil individual or departmental information needs, and is not devoted to and does not understand the importance of BI.

(Tactical)

Metrics are usually used at department level only. Off-the-shelf applications with few or no modifications are used, and the users are not skilled enough in order to take advantage of the system.

(Focused)

Management dashboards are often requested at business unit or department level. Their goal is to optimise the efficiency of individual departments or business units, but is not related to the broader company goals. Users are trained for basic functionalities of data retrieval systems.

(Strategic)

Information is available to all employees of the company. Data management policy and data quality metrics are in place. Strategic information becomes trustworthy and is used for strategic decision-making. Users are adequately trained for data processing and are able to use it effectively for strategic and tactical decisions.

(Pervasive)

Processes become pervasive across all areas of the business and across part of the corporate culture. Users at different levels have access to information and to the analysis needed for creating a business value and influence business performance.

Business Intelligence Maturity Hierarchy

(Stage 1: Data)

Organisations collects, cleanses, standardises and keeps data from different sources consistent. The goal at this stage is to establish integrated, clean and high quality data.

(Stage 2: Information)

Organisations start using integrated and high quality data by assigning a meaning to them. They are now capable of identifying key success factors in order to use them to produce dashboards so that information on business performance and activities are clearly defined and easy to read and understand.

(Stage 3: Knowledge)

BI at this stage is used to perform “what-if” analysis and pattern analysis, in order to identify individual trends, so that this knowledge can be used in business processes.

(Stage 4: Wisdom)

Organisations have now higher business productivity; and are able to make sound, in time and efficient business decisions, in order to give the company great competitive advantage by reaching business goal and producing development goals and service quality.

Business Intelligence Maturity Model

Recent state-of-the-art analysis of Business Intelligence Maturity Models revealed common shortcomings: a lack of theoretical foundation, inadequate documentation and especially the dismissal of methodical requirements [38].

In order to overcome such shortcomings in this domain, and to provide a comprehensive and accurate BI maturity assessment instrument, *Raber et al.* [34] developed a Business Intelligence Maturity Model depicted as follows.

	Level 1 **Initiate**	**Level 2** **Harmonize**	**Level 3** **Integrate**	**Level 4** **Optimize**	**Level 5** **Perpetuate**
Strategy	Decentralized IT-driven BI	Centralized IT-driven BI	Business sponsor, initial BI strategy	BI portfolio management and BI business cases	Comprehensive BI strategy and BI performance management
Social system (organization)	Decentralized, individually acting BI organization	Standardization of operations, tools, applications and development	Centralized with respect to business model	Well-defined governance and business content	
Technical system (IT)	Decentralized, non-standardized BI infrastructure	Decentralized, but harmonized systems	Centralized with respect to business model	Flexible, pro-active analytics	
Quality of service		High availability and proper maintenance	Data and system quality is guaranteed	Cost-efficient BI operations	Pro-active data quality management
Use /impact		Top management and operational usage	Specialized analysts	Middle management	

Figure 7 – Condensed BI Maturity Model [34]

Level 1 – Initiate

Organisations have a high degree of decentralism with almost no standardisation efforts, representing an early and immature state of Business Intelligence.

No “use/impact” items exist on this level, since the items represent rather organisation-wide usage of BI and only few users use BI at this level.

Level 2 – Harmonize

At this level, organisations begin to be oriented towards centrally managed BI in terms of governance and organisational setup. Beginning of standardisation efforts regarding operations, development, tools, processes, and applications through the creation of consistent policies. Initial use of standardised master data.

Level 3 – Integrate

This level represents the final step towards centralisation and integration, and the Organisation is now able to define an initial BI strategy focused on technology and tools and employs specialised BI analysts.

Level 4 – Optimise

At this level, organisations are realising the full potential of Business Intelligence by providing flexible and pro-active analytics to achieve business impact. Middle management is widely engaged in BI usage.

Level 5 – Perpetuate

In order for organisations to achieve the highest maturity level, sustainable and continuous management of BI needs to be established. This final stage of maturity requires a comprehensive BI strategy to be specified and regularly updated.

Focus Area Maturity Models [33]

Numerous maturity models have been developed over the years, most of which are defined as "fixed-level" models. Fixed-level maturity models are usually characterised by a fixed number of generic maturity levels - usually around five -, where each maturity level consists of a series of processes that have to be implemented.

Fixed-level models are well suited to benchmarking, but not so much for incremental improvement, as they cannot capture interdependencies between the various processes in each maturity level. There is thus a lack of models that provide support in incrementally improving particular domains and grasping the unique configurations of real-world organisations. In fact, a recent Maturity Models overview and analysis concluded that "Many companies have their departments at different levels of maturity" [37].

M. Steenbergen et al. [33] defends that the notion of generic maturity levels is an oversimplification and that different dimensions must have different maturity levels, and even that each focus area must have its own number and type of maturity levels.

Focus area maturity models are based on a number of focus areas that have to be individually developed in order to achieve maturity in a functional domain. Such models define a method to develop step-by-step improvement in each focus area in order to reach progressively mature capabilities in specific functional domains, and allow to picture different evolution states in a given domain.

In order to grasp the proposed methodology, an example of Focus Area Maturity Model is depicted bellow.

Maturity Scale / Focus Area	0	1	2	3	4	5	6	7	8	9	10	11	12	13
Development of architecture		A			B			C						
Use of architecture			A			B				C				
Alignment with business		A				B				C				
Alignment with the development process			A				B		C					
Alignment with operations					A			B			C			
Relationship to the as-is state					A				B					
Roles and responsibilities				A		B					C			
Coordination of developments							A			B				
Monitoring				A		B		C		D				
Quality management								A		B			C	
Maintenance of the architectural process							A		B		C			
Maintenance of architectural deliverables					A			B					C	
Commitment and motivation		A					B		C					
Architectural roles and training				A		B			C			D		
Use of an architectural method				A						B				C
Consultation			A		B				C					
Architectural tools							A				B			C
Budgeting and planning				A							B		C	

Figure 8 - Focus Area MM for the Functional Domain of Enterprise Architecture [33]

In this example, the functional domain under analysis is the one of Enterprise Architecture. Focus Areas (or activities) of the functional domain are listed on the Rows of the matrix, while the Columns represent progressive overall maturity scale (From 0, being the lowest, to 13, being the highest).

Each Focus Area has progressively mature capabilities (defined as A, B and C), which will define maturity evolution through the maturity scale. In the Enterprise Architecture example, the capabilities are defined as follows:

A – Architecture used informatively

B – Architecture used to steer content

C – Architecture integrated into the organisation

In this MM, an organization is said to be at the maturity scale represented by the rightmost column for which the organisation has achieved all focus area capabilities positioned in that column and in all columns to its left. Thus, despite the development of some of the focus areas, on the whole, the organisation in Figure 8 is still only at maturity scale 1.

5.2 Enterprise Modelling

Organisations are regarded as complex systems that emerge from the interactions among human and non-human agents. It is common that employees know what they are doing (their daily tasks) and how they accomplish those tasks, but they often don't know why they are doing it, i.e., what are the causes and effects of their work in the organisation as a whole [39].

In order to facilitate the communication among organisation stakeholders and provide means for them to have such a global vision, recent evolution of the Information Systems field has been marked by the emphasis given to models and modelling activities [40]. Two computer science fields have addressed Enterprise Modelling (EM), mainly to support the development of business applications: Information Systems – through the use of Enterprise Architectures -, and Artificial Intelligence – through the use of Enterprise Ontology -.

In both fields, the proposed frameworks are essentially focused on activities, and lack capturing individual behaviour. Moreover, since those dynamics can only be deduced from actors' roles and activities, the referred frameworks are unable to model the actual behaviour of specific individuals, rather modelling their generic, expected behaviour. An additional issue of existing EM frameworks is that they have no means of reflecting the different and frequently incoherent views that different agents have of the organisation [40].

In order to address all those issues, *M. Zacarias et al.* proposed a framework to enrich EM by capturing and representing personal and inter-personal work patterns from actual actions and interactions, and relating them with enterprise activities and resources [41].

A 'context-aware' agent-oriented ontology [40]

The suggested framework is built upon five fundamental concepts:

1. Resources

   Resources are the entities required for the operation of an organisation. They may be *physical* (e.g. people, documents, machines, tools), *abstract* (e.g. information, ideas, concepts), *active*, i.e. capable of active behaviour (e.g. people, machines, information systems) or *passive*, i.e. only brought into action by active resources (e.g. documents, information, tools).

2. Activities

   Activities are descriptions of what organisations do. The definition of those organisational activities implies shared understandings among participating subjects about the set of resources used (inputs) or produced (outputs), its specific outcomes, and the procedure required to transform inputs into outputs.

3. Agents

   Agents are a special kind of physical and active entity, which have the following capabilities:

   - Performing, coordinating and (re) designing activities
   - Providing, consuming, managing, and (re) designing resources
   - Monitoring, coordinating, and (re) designing their own activity, as well as the activity of other agents

Actions are operations performed by agents to change the state of a given resource-related item. They describe what organisational agents do.

Interactions are ordered pairs of communicative actions exchanged by two given agents, where the second action is a reply to the first.

The agent-resource duality: As entities, agents are also resources.

4. Roles

Roles are the observable behaviour of agents in particular situations. This ontology defines three role types, each one corresponding to a different behavioural concern: performer, coordinator, and designer.

5. Contexts

Contexts are the network of entities (agents, resources, and rules) that are relevant for an agent in a given situation. In each context, the participating agents play specific roles that define the type of actions performed and resources exchanged.

Interaction contexts are networks created by recurrent interactions between two given individuals.

The main purpose of the proposed framework is to be used as a tool to represent and analyse different behavioural concerns of human agents, seeing that current ways of modelling organisations do not reflect the complexity and adaptability of intelligent agents, neither it reflects the situated nature of their behaviour.

It thus follows an Agent-Oriented modelling method, encompassing a series of agent levels, with associated modelling concepts:

"Single-Agent" Level

This level focuses on single-agent multitasking capabilities and activation/suspension of roles related to the task performed at a given moment, eventually consuming resources (e.g. Agent is programming - programmer role-, after feeding the dog - pet owner role-).

Those capabilities are linked to responsibility, permission, right and obligation concepts, as well as events, actions, tasks, goals, plans and actor position.

"Two-Agent" Level

This level represents a collective agent composed of two individuals, called as *dyads*. Dyads define relations between two single agents and they are an essential building block of social networks.

Related concepts are interaction protocols, dependency relationship, and inter-agent commitment.

"2-More Agents" Level

This "Group Agent Level", represents *groups of individuals* acting as one. They generally have a group structure; follow a common goal and act following a joint intention and commitment

"All Agents" Level

This level represents the *whole Organisation*, following organisational structure, rules and patterns. It is generally guided by social an interaction rules.

In addition to capturing this notion of different agent levels of complexity, it is crucial to provide means of tracing different behavioural patterns of a single agent, and therefore linking agent behavioural concerns with other enterprise perspectives.

Acknowledging those nuances, the proposed ontology is organised in 3 interdependent layers [40]:

Action Layer

At this layer, agents are regarded as *actors* having collections of *action strategies*, defined as *conditional* action patterns employed in *specific circumstances*. This layer allows capturing and modelling individual and inter-personal action/interaction patterns employed within particular contexts.

Deliberation Layer

This layer models agent rational and coordinative properties, and aims at capturing deliberative behaviour such as coordination, planning, scheduling, or decision-making.

Change/Learn Layer

This layer acknowledges agent adaptive, not fully predictable, and rugged properties.

At the change/learn layer, agents are regarded as designers that create, modify and eliminate strategies. When agents change their own strategies, they are 'redesigning' themselves.

The Framework [40]

Building on all previously defined variables, this framework aims at addressing both agent and organisations complexity through an integration of agent and enterprise architectures: the organisation is modelled as a dynamic network of activity and resource-related agents.

This way, it can fulfil its purpose of capturing agent-enacted behaviour, as opposed to traditional modelling of expected behaviour. By capturing this kind of information, one is able to uncover individual and collective work practices and to evaluate how these practices evolve in time [42].

The conceptual framework suggests [42]:

(1) A separate modelling of the different complexity levels of agent behaviour.
(2) Agent observable behaviour (action/interaction patterns) may be captured from its actions.
(3) Agent behaviour cannot be dissociated from their contexts of execution.
(4) The nature of these contexts depends on the complexity level addressed.

Figure 9 depicts the Framework-defined agent architecture and dynamics, which may me applied at the several levels of detail: individual, inter-personal, group and organisation levels.

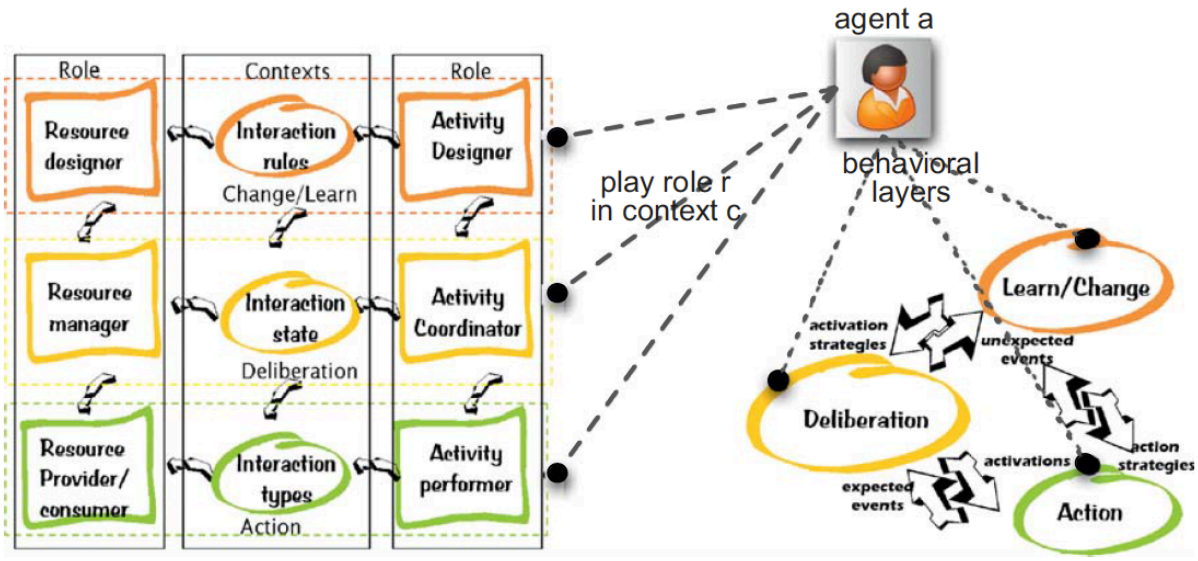

Figure 9 – Framework Agent Architecture and Dynamics [40]

Depending on the layer, the notion of context varies: in the action layer, contexts are regarded as networks of interacting agents and resources created by the execution of one or more activities; at decision-making layer, they represent the set of shared commitments among interacting agents; at design layer, contexts define the set of unobservable rules governing agent behaviour [42].

The actual agent behaviour results from interplay between agent autonomy and the behaviour determined by its activity and resource-related roles. Consequently, different agents playing identical roles exhibit similar, but non-identical behaviour, thus confirming that human agents do not fully follow prescribed behaviour, but rather cause deviations between designed activities and execution [40].

5.3 Enterprise Transformation

"In a time when technology has made the world smaller and important events take place at an incredibly high pace, organisations constantly need to adapt themselves in order to survive." [40]

Organisations are complex, adaptive, socio-technical systems of interacting agents, forced to change at an increasingly higher pace as environment forces challenges them: economic pressures from competitors, as well as politically, socially or technologically-induced changes [43].

Enterprise Transformation is defined as a designed and fundamental change, in contrast to ad hoc, routine change. It is a purposeful steering intervention into an enterprise's evolution, in order to respond to perceived opportunities, deficiencies or threats [44].

In order to deal with Enterprise Transformation, *R.Abraham et al.* [43] introduces the use of Control Theory, in order to describe dynamic aspects of the Organisational system, turning to the concept of feedback loops.

Feedback Loops [43]

A feedback loop consists of an observer that records environmental data, a modeller that interprets the data and calculates corrective actions, and a controller that influences the system based on the input from the modeller.

The controller component is thus able to compute corrective measures by constantly observing system states and comparing observed data against system goals, and subsequently changes system variables in order to realign them to system goals. Model updating mechanisms are crucial: if the observer or modeller part in any feedback loop fails, then the system cannot be purposefully controlled or transformed.

K. Åström and R.Murray illustrated the feedback loop with a vehicle system controller, as depicted in Figure 10.

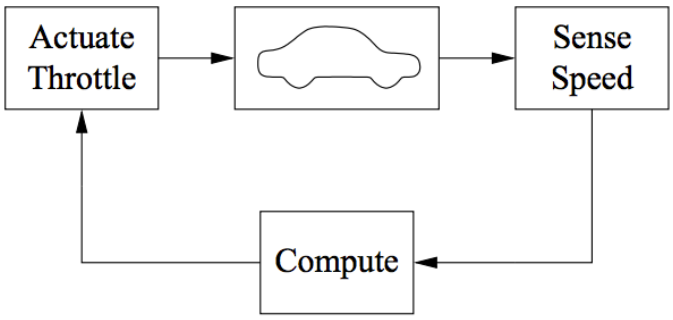

Figure 10 - A feedback system for controlling the speed of a vehicle [45]

The speed of the vehicle is measured and compared to the desired speed within the “Compute” block. Based on the difference in the actual and desired speeds, the throttle – or brake – is used to modify the force applied to the vehicle by the engine, drive train and wheels [45]. The actual car speed can thus be kept as close to the desired speed as possible.

In that way, this vehicle feedback loop consists of an observer (“Sense Speed”), a modeller (“Compute”) and a controller (“Actuate Throttle”). In a complex system, there may be several feedback loops operating in parallel (e.g. loops for climate control, regulating the air condition in the passenger cabin, etc.).

This example illustrates that for a system to be controllable, it necessarily needs to be observable: if the car speed cannot be sensed, it cannot be controlled. However, being observable is not sufficient for being controllable: if only the sensor worked, but not the components that compute speed adjustments and actuate the throttle, the car would still be uncontrollable. Additionally, not all observable variables are controllable [43].

Applying the feedback loops theory to the business context, organisations can be considered as complex systems in which several feedback loops run in parallel. In that way, *R.Abraham et al.* illustrates feedback loops in enterprises as depicted in Figure 11.

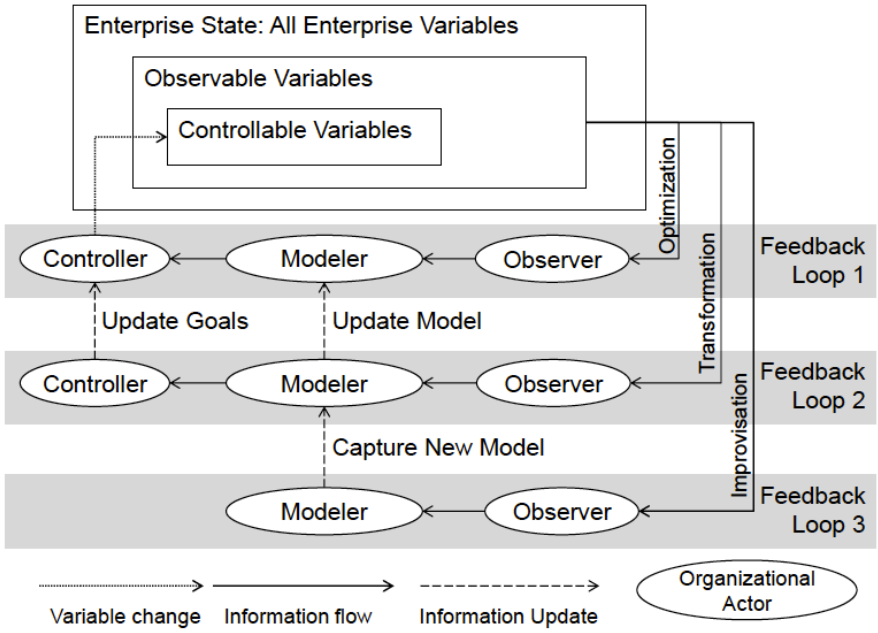

Figure 11 - Feedback Loops in Enterprises [43]

Enterprise State

Enterprise State consists of all enterprise variables, which define the Organisational Configuration at a given moment in time.

Observer

All observable information provides inputs to the observer. Overall descriptions of business processes, performance indicators and dashboards provide information on various organisational subsystems.

Modeller

Set of business rules and policies established in order to guide the implementation of the overall goals. These policies and business rules enable to restrict design freedom of organisational agents.

Controller

Change controllable variables in order to achieve the design of the new organisational configuration.

As enterprises are never inert, but constantly subjected to environmental turbulences, their continuous transformation processes must be decomposed into several feedback loops in order to be analysed.

An enterprise has a certain state at each moment in time, and consists of a set of observable and a set of controllable variables. Depending on the degree of environmental turbulence the enterprise encounters, one or several of the following feedback loops are triggered [43]:

Feedback Loop 1 runs permanently, whereas Feedback Loops 2 and 3 are only triggered by unknown exceptions in the environment and therefore run less frequently.

Feedback loop 3 is only triggered by unpredictable, sudden exceptions – and requires improvisation –, which occur less frequently than predictable exceptions leading to purposeful transformation in Feedback Loop 2.

Previously unknown exceptions are added to the pool of known exceptions after they have successfully been handled.

The success of Enterprise Transformation depends on the existence and use of feedback channels that allow each organisational actor to act as observers, detecting model changes within their domain and propagating this data into models. Organisational actors carry out assigned roles with authority and responsibility and may either be individuals in roles, or groups of individuals acting as boards.

6 Thesis Evolution

6.1 Updated Thesis Problem

Building upon the experiences and the knowledge extracted from the first iteration at *Moviflor* in combination with the newly explored concepts, the initial Thesis Problem as now substantially evolved.

Conclusions drawn from the reality check at *Moviflor* showed that bringing a Business Intelligence system into an Organisation is a complex task. In order to truly empower the organisation as a whole, such a system must bring systemic value, accurately grasping and satisfying global needs.

The gradual organisational evolution towards Business Intelligence must aim at enabling business value creation through its use, in order to consolidate organisational growth. Organisations must know how to accurately manage their information, and have realistic and adequate views of themselves – "organisational self-awareness" – in order to build a sustainable future: "Why do we want BI?", "In order to achieve What?", "For who?", "How?".

This organisational evolution must be a sustained evolution, effectively adjusted to enterprise reality: the Organisation must learn to walk before it can run.

The focus of this research must now adjust to find a way of analysing Organisational use of information, in order to provide a definition of the potential business evolution towards Business Intelligence. Hopefully, this will enable Organisations to avoid judgmental errors leading to bad Organisational implementations.

In order to reach sustained evolution, Organisational maturity must be taken into account and carefully analysed, so that it is possible to understand if required foundations exist for the Organisation to evolve.

Additionally, the first iteration at *Moviflor* showed that an Organisations' ability to collect and store information about its execution is not enough for that information to accurately be delivered to its employees. If there is a lack of updated enterprise models for organisational actors to consult and navigate, it is impossible for them to gain awareness about the valuable information existing in enterprise databases.

So, this research must aim at finding engineering methods suited to organisational maturity evolution of its actor's use of information, eventually culminating in Business Intelligence.

6.2 Problem Reformulation

In order to update this research problem, we need to synthesise the important notions brought by all de experiences from the first DSR iteration, which allowed shedding a new light on the initial thesis.

The important notions of **information use** and **enterprise maturity evolution** motivate a problem reformulation in order to design a better-suited artefact than the one initially idealised.

The focus here is thus to construct a design method to describe evolution paths of an organisations' maturity, regarding the way its actors use information in order to perform actions.

It is essential to understand the way information is used in an Organisation, as well as overall informational needs before being able to talk about Business Intelligence, which must be dealt with on a posterior phase.

This thesis-reformulated problem will thus be defined as a

"Bottom-up approach to define Maturity Evolution paths for Organisational use of Information."

By solving this problem of defining paths to follow along the maturity evolution in an Organisations use of information, it will be possible to answer the following questions:

Q1: Where to evolve, in order to reach our goals?

Q2: How to evolve?

Q3: Who is involved in the Maturity Evolution paths?

7 Solution Development

7.1 Solution Domain

Maturity Evolution Paths

The scientific research carried out in order to extend the initial knowledge base brought important insights on enterprise maturity and transformation.

Maturity Models are usually “one size fits all”, having predefined dimensions and levels, and are to be applied to organisations as a whole, disregarding the fact that Organisations can contain areas with disparate maturity states. Since Organisations differ strongly from one another, each one having its individual particularities, those models cannot be blindly applied and not take into account unique Organisational configurations.

Through the interviews undertaken at *Moviflor*, results showed that information capture and use is very different in distinct organisational areas (See Section 4.2). We can thus begin to understand that a particular organisation can have its departments at distinct levels of maturity, although further analysis will have to be done at *Moviflor* to investigate this topic.

Additionally, since it is possible for Organisations to present distinct maturity levels in their business units, and combining the Focus Area Maturity Models with the studied Business Transformation theories, it is logical to infer that Organisations do not evolve uniformly. Evolution can take place in particular business units, bringing Organisations to combinations of diverse maturity states.

Thus, and as Organisations are unique and different from one another, each Organisation will have unique evolution paths. As it is, the maturity evolution paths we proposed to define will be “Meta-Evolution Paths”, as they are not unique ant rigid paths, rather representing approximate possible paths that can be adapted to a specific Organisation.

Essentially, Organisations must have self-awareness about their maturity state of information use, so that it is possible for them to diagnose their ‘AS-IS’ and ‘TO-BE’ states of maturity, in order to define realistic paths of maturity evolution. It is only by having this kind of integrated views about themselves that Organisations will be able to fulfil their mission, vision and strategic goals. Moreover, operational reality must always be taken into account, combined with enterprise strategy, in order for them to thrive.

Information Use

Information is crucial in order to make decisions and act. Business Transformation theories give us important insights on the processes through which organisational agents observe variables in order to act, through their previously modelled decision-making routines.

Agents need a set of information in order to make a set of informed decisions in their particular contexts, considering the scope of their authority and responsibility domains. This represents the core of enterprise need for information and enhances information utility.

At *Moviflor*, there is a good level of awareness about which information exists, which information is needed, and about the information instantiation in the business execution (See Section 4.3).

Besides from the definition of maturity evolution paths, it is important to define the role of information as well as agent behaviour in information use at distinct agent levels.

It is also important to understand individual information needs in order to understand the readiness to evolve - “Are we mature enough in order to evolve?” –, and ultimately assess organisational readiness to take the leap into Business Intelligence – “Is BI really adequate, and needed?” –.

7.2 Back to *Moviflor*

The second iteration at *Moviflor* consists of a survey carried out to 6 employees from different hierarchical levels in 3 distinct key-areas: Sales, Logistics and Management Group. The goal of this survey is to grasp the different experiences in those 3 key-areas, concerning the new topics of interest.

So, the questions asked revolve mainly around employee functions and context, information use and available tools, and information needs, resulting on the following structure:

- Subject functions and context
    - Main Functions
    - Nature of the subject activities
      (Structured and normalised activities or rather unstructured)
    - Decision-making characteristics
      (Mostly individual or collaborative decision making)

- Information and tools
    - Main tools used
    - Nature of information *(Personal or Shared information)*
    - Perceived information reliability *(Trustworthy or not)*
    - Dashboards availability in order to support decision-making process

- Information Needs
    - “Name and describe 6 most important Informational needs”
    - “Does any of the previously described information presently exist?”

The goal of the online survey is essentially to grasp agent complexity, information maturity, information use and information needs.

Details about the surveys carried out at *Moviflor* can be found in Appendix A – Interviews and Survey Methodology.

The survey itself can be seen in Appendix B – Survey Conducted at Moviflor.

Conclusions from Surveys

Combining the results obtained in the first and second iterations at *Moviflor,* some conclusions can be drawn:

Management Group

The Management group has access to execution reports where they can consult key information that enables them to better execute their tasks. Those reports are manually processed by extracting and aggregating the information that serves each manager interests, and are adapted to their individual business areas.

Those manually developed reports are available monthly in addition to the SAP ERP system reports, which are manually parameterised views provided by the system to satisfy individual needs (see Section 4.1).

The needs felt at this level are essentially related to the obtainment of timelier information that allows for updated business execution views in each department, as well as more detailed and thorough information that allows to predict future business trends (e.g. by correlating business events).

Sales

In the sales unit, Store Managers have more rudimentary needs. The nature of their daily tasks implies for them to make ad hoc decisions, where few or no standardisation exists for critical decision-making processes. They have to make strategic decisions based on SAP ERP system information and previously described reports (e.g. on stocks, rotation, exposed material, etc.)

Some of the described rudimentary needs consist of:

> Cost information on specific stores: Store Managers have no timely information on their store expenses – water, energy, communications, office supplies, etc. – in order for them to accurately manage such expenses;
>
> Trustworthy information on client complaints and on schedule-removed materials that couldn't be delivered due to lack of stock: that information is shared and exchanged between the stores and the Call Centre generating some information deficiencies;
>
> Information on Supplier Discharges of incoming material: sometimes, scheduled Supplier Discharges incoming to the Store Warehouse are postponed or cancelled, and the information on such events is sometimes incomplete or even missing on the SAP ERP system.

Additionally, the available reports are not correctly employed, seeing that the information is not accurately detailed - namely on the "Sales support panel" – and there is a general feeling that the use made of available tools is not optimal.

Logistics

In the logistics unit, at a more operational level, where processes are totally standardised and all activities follow pre-defined norms, no informational needs are felt. Timely reports and dashboards are available and satisfy individual operational needs and guarantee expected performance.

At a more strategic level, where daily activities are less standardised and require ad hoc managerial decisions (e.g. Distribution Centre Management), there are more rudimentary needs, similar to the Store Managers needs.

Some of the information needs that are currently not satisfied are:

Timely cost information on the Distribution Centre (as previously described on the Sales unit information needs);

Detailed cost information on transportation: this information is relevant in order to assess distribution zones profitability, as well as to evaluate detailed expenses on internal transfers (i.e. material transfer between warehouses and Distribution Centres);

Statistical Information on Quality Control: detailed information on overall Quality Control processes (inspections, inspected materials, unconformities, etc.);

Supply failures: aggregated information on missing materials that prevented the team from fulfilling customer commitments.

Global Organisation

Distinct organisational agents present distinct characteristics associated with different maturity levels throughout the organisation, depending on their business area and the domain of their activities.

Distinct Business Units present distinct configurations and distinct information needs depending on the nature of agents' activities (e.g. individual or collaboration decision-making process, activity standardisation, etc.)

Most organisational agents are dealing with daily operational execution and are only concerned with what information they need in order to optimise operation-related activities. The concept of exploring future opportunities through intelligent use of information (e.g. predictive analytics) is not yet in sight. As it is, they are not yet feeling the need to evolve to this kind of information use, and are still optimising their current performance.

In some cases already detected in the first iteration at *Moviflor* (see Section 4.1), more experienced managerial agents have a more mature vision of information needs. Those already intend to further analyse and process data in a more thorough way, detecting patterns and providing intelligent information to organisational agents in order to enable an overall performance increase.

In general, information exists and is based on highly mature and reliable data. It is even possible, and sometimes feasible, to extract timely and extremely accurate information – at a great cost –. That does not imply that agent awareness towards the available information exists, due to the lack of updated models for them to consult and navigate in their action context.

We can thus conclude that information and extraction tools exist but are not optimised or not adequately used. Nevertheless, this configuration enables to foresee an eventual evolution towards *Business Intelligence* and is a good foundation to it.

7.3 Solution Design

A "Bottom-Up Approach"

In an effort to simplify what can be seen as a complex interplay of actors in a multifaceted ecosystem, *M. Zacarias et al* proposed a noteworthy agent-oriented Framework, previously introduced in Section 5.2. This Framework helps breaking down the Organisational structure in different complexity levels, and will be the basis for our "bottom-up" solution feature.

In fact, our "Bottom-Up" approach does not consist of a "Hierarchical Bottom-Up" – in which the Organisational structure is decomposed in business units and progressively builds up to the top management layer – but rather a decomposition of agent complexity into a series of agent levels, and associated behavioural patterns.

This approach will consider the previously defined levels of complexity:

- **Single-Agent**
- Two-Agent, or **Dyad**
- 2-More Agents, or **Group**
- All Agents, or **Organisation**

Behaviour at each Agent individual level will affect the rest of the Agents throughout the entire Organisation. Distinct behavioural patterns depend on the layer in which agents are performing (as previously studied in Figure 9). Nevertheless, in order to simplify the construction of our solution, the behavioural layer combination with agent contexts will not be further analysed.

We will thus maintain a simplistic view of our agent-oriented "Bottom-Up" approach, as depicted in Figure 12.

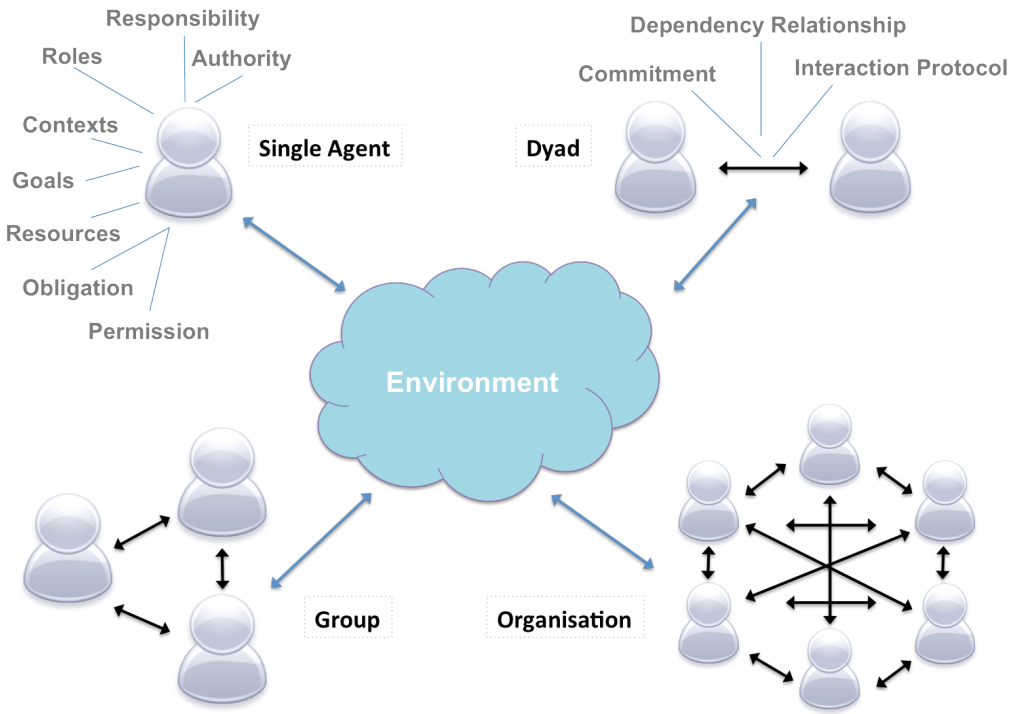

Figure 12 - Bottom-Up Approach

Single Agent Level

This level consists of a Single Actor playing one or more roles, eventually in different contexts – elementary link between the individual and its actions: high granularity –. The single-agent acts in a well-defined domain with a well-defined and sequential set of activities.

Dyad Level

Two single agents interacting, adding to the "Single Agent Level" concepts of interaction, mutual dependency and commitment.

Group Level:

Extended network of Agents interacting – adding complexity to the previous "Two-Agent Level" –, which need to deal with much complex concepts like group structure, common goals and joint commitments and intentions. They have to communicate, interact and collaborate in order to make coordinated decisions.

Organisation Level:

This level is the highest level of organisation complexity, encompassing all agents in a complex interplay of intersections of countless semantic plans. Their internal communication is essential for them to make orchestrated actions. At this level, agents have to deal with social and interaction rules, overall Organisation rules and patterns.

When processes are on only one well-defined domain, it is possible to define what is needed in each individual context. With the increase in semantic plans, this task becomes more complex, because joint agent needs are more difficult to grasp due to the combination of individual agent complexities. Additionally, the increase in agent number in the overall decision-making process brings more complexity due to each agent's influence in other agents' decisions (e.g. Agent A will make an informed decision based on the outcome of Agent B decision, etc.)

This bottom-up approach allows us to gradually increase in complexity while keeping a structured and simplified vision of the organisation. By building up on those simple notions, we are able to understand that an organisation, in every moment, is composed of unique agent configurations.

Defining Organisational Use of Information

Theoretical foundations on Business Transformation (Section 5.3) brought us very important and useful insights into what will be the foundation for the analysis of agent use of information in enterprises.

The notion of Feedback Loops in Enterprises (as seen in Figure 11) and further definitions of its basic notions of **Enterprise State**, **Observer**, **Modeller** and **Controller** will be useful in order to understand the decision-making process of organisational agents and the way they use and process information.

Applying those notions of Control Theory and Feedback Loops to our research object, we are able to construct the following "Agent Decision-Making Feedback Loop" process:

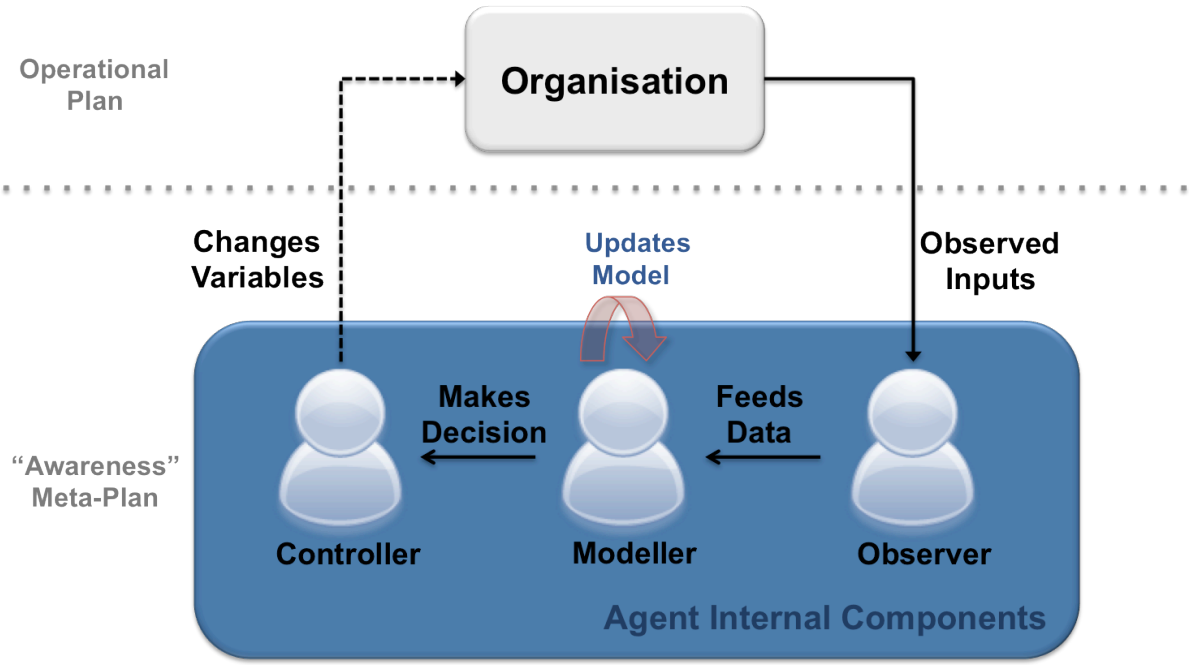

Figure 13 - Agent Decision-Making Feedback Loop

1) Agents need a set of inputs (**Observed Data**) in order to make a set of informed decisions in their particular contexts, considering the scope of their authority and responsibility. Those inputs are observed resources (Active or Passive) and their individual state in a given moment.

   Applied to this research context, such resources are data with associated states that represent the meaning of the data in a given moment in time (Data + Meaning = Information).

2) The Agent then processes the inputs against his current mindset (The **Agent Modelled View** of the Organisational state), which consist of its interpretation of the world at that precise moment.

   This Agent interpretation – or conceptual map – of the Organisation enables him to compute the observed inputs and eventually update his initially modelled "World View".

3) Finally, according to the decisions he made, the Agent acts and changes the controllable variables of the Organisation – not all the observable variables are controllable – (**Controller** action). In most contexts, the Agent will not have complete control over its environment, having rather partial control, and is thereby capable of influencing it.

This feedback loop and its components are part of the agent context and therefore influence agent views: two distinct agents will have distinct views on the same organisation at the same moment in time, depending on their contexts.

At each moment, the feedback loop will exist on two plans of the Agent context: the Operational Plan – Organisation configuration, with all its variables, its subset of observable variables, and its sub-subset of controllable variables (see Section 5.3) –, and a meta-plan, here called the "Awareness Plan", where the observer, modeller and controller stages of the loop take place.

Observed, Modelled and Controlled informational entities are the same ("All variables") and, if the Organisation Information Architecture enables them, its Agents will have a common view and understanding of those entities.

Having established this "Agent Decision-Making Feedback Loop", we can further combine it with our "Bottom-Up Approach".

In reality, the studied decision-making loop can **uniformly be applied to all levels of agent complexity**, since the Feedback Loop will be the same whether we are studying individual or collective Agents. In fact, the Observer, Modeller and Controller components of the "Agent Decision-Making Feedback Loop" can be seen as a "black box", since the overall process will be exactly as previously described, regardless of what happens inside the "black box" (i.e. The internal mechanism upon which agents observe information and consequently decide to make determined decisions in order to act).

This concept is further illustrated in Figure 14:

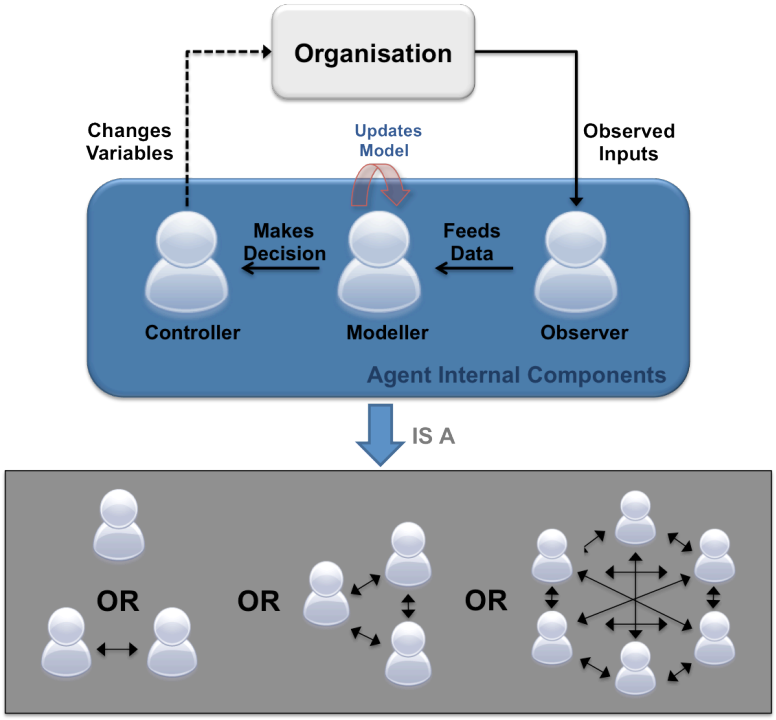

Figure 14 - Feedback Loop with "Black-Box" Agent

The behaviour of the "Modelling" step can be considerably different according to Agent complexity: the decision-making process of a "Single-Agent" with its individual decision will be substantially less complex than the "Two-Agent" collaborative decision-making process, which in its turn will be much less complex than the "2-More Agents" group decision-making process, etc.

Nonetheless, this internal behaviour does not change the way data is observed (inputs) neither the way the agent decision (outputs) will impact on the Organisation variables (i.e. The way the controller changes Organisational Configuration). It is thus irrelevant to further analyse this internal agent mechanism, given the scope of the present research.

Distinct agent contexts and action scope will imply situated decision-making processes (e.g. Store Manager Agent decisions are different from Warehouse Manager Agent decisions), but the overall "Agent Decision-Making Feedback Loop" will be the same.

Fully and clearly expressed, this Feedback Loop allows for individual agent self-awareness, which is the basis for a bottom-up approach towards the entire Organisation self-awareness.

Searching for Maturity Evolution Paths

Summarising the conceptual foundation on Maturity Models (See Section 5.1), we can extract recurrent maturity level characterisation of topics of interest for this research. This will allow us to have a better understanding on maturity evolution of organisational dimensions like Information, IT, and Processes.

Level 1 – LOW [16], [36], [37], [46]

- "Information anarchy": Poor data quality and inconsistent data. The Organisation struggles to fulfil individual and departmental information needs
- Incorrect and inconsistent data interpretation: lack of Information Architecture
- Actors only have access to their own information. Lack of information sharing between actors lead to incoherent information
- Many Heterogeneous IT solutions: multiple databases and information repositories.
- Accessing data is difficult
- There are no defined standards (For IT, Business Processes, etc.)

At this level, the information requirements focus is on the **"*what*"** users would like to be delivered. The perceived data warehousing benefits centre on improved and timelier end-user access to information.

Level 2 – MEDIUM [16], [36], [37]

- Standards for a few processes exist, with assigned responsibilities.
- Some global applications for few processes exist
- First data and Information Systems are harmonised: beginning of Information Architecture
- First global reports are created, based on newly centralised information
- First global organisational concepts are defined
- Off-the-shelf applications with few or no modifications
- Users are not skilled enough in order to take advantage of the system, only for basic functionalities of information retrieval
- Metrics and management dashboards begin to be used, but only on department level. Their goal is to optimize efficiency, but is not related to broader company goals.

At this level, information requirements focus is on the **"*what*"** users would like to be delivered, as in Level 1.

Level 3 – HIGH [16], [36], [37]

- Cross-company processes are defined and process owners are identified. Process know-how is well established throughout the company.
- Global IT Strategy is defined, and standards for systems and data are established
- Master Data is harmonised: optimisation of Information Architecture design
- Data management policy and data quality metrics are in place: strategic information becomes trustworthy and is used for strategic decision-making.

- Information is available to all company employees, which are adequately trained for data processing and are able to use it effectively for strategic and tactical decisions

At this level, end users start to seek the answer to ***"why"*** the information is needed (not only ***"what"*** is needed). They begin to wonder ***who***, ***when*** and ***where*** this information fits into the business processes that support business goals.

Level 4 – HIGHEST [16], [36]

- The entire organisation thinks in processes, improve them permanently and adapts them flexibly to new requirements
- Global and Integrated IT Systems are in place, with state-of-the-art technology
- Processes are well documented and optimised, with quick adaptation to market requirements
- The organisation is flexible and global, centred on permanent improvement and innovation
- Users at different levels have access to required information and reports for creating business value and enhancing business performance
- Implementation of new decision processes that optimise information usage throughout the whole organization.

At this level, the organisation tries to find ***"how"*** existing processes can be improved if the information is available and *"how"* information, put into business use, can best be used in business processes.

Putting the Pieces Together

Having defined and described what we called the "Agent Decision-Making Feedback Loop" and summarised maturity levels of information, processes and IT, we must now combine both in order to reach our proposed solution for a **"Bottom-up approach to define Maturity Evolution paths for Organisational use of Information."**

We thus propose that, in order to define Maturity Evolution Paths for Organisational use of Information, the objects of maturity assessment and evolution are the components of our "Feedback Loop": the Observer, the Modeller and the Controller. Each one of those components can have distinct behaviours, depending on information use in a given Organisation.

We argue that maturity levels do not change continuously, since they are rooted in people. The evolution thus takes place in the organisational agents: it is them who need to evolve by learning, and ultimately contributing to overall business transformation.

Based on the previously defined Agent Decision-Making Feedback Loop (see Figure 13), we argue that the combination of Observer and Modeller contains attributes of information maturity – observed and modelled information –, whereas the combination of Modeller and Controller have attributes of decision capabilities – which define agent authority and responsibility in his decision-making process with subsequent action-taking –. The alignment between those two facets is essential in order to

guarantee an optimal decision-making process: information maturity combined with adequate agent qualifications in order to make decisions.

If the Organisation struggles with inconsistent and incoherent data, the poor data quality will make it impossible for Agents to have reliable inputs: there is thus no correctly Observable information (i.e. The Observer is at a Low Maturity Level).

As opposed to that, if the Organisation has outstanding data quality and provide timely and relevant information and reports, optimised for specific agent's needs, the Observer will have optimal conditions to perform its daily activities with no additional effort (i.e. The Observer is at a High Maturity Level).

There may be circumstances where an individual Agent maturity level does not comply with the overall organisational maturity level: in those cases, the Agent maturity will be misaligned and will constitute an exception or deviation to the overall organisation maturity (e.g. In Organisation 'X', which is considerably mature in its use of information, Agent 'A' deals with an informational entity which has not been contemplated by the organisation information architecture. He is thus not able to accurately observe this entity. His maturity level of information use will be below the overall organisational one.)

Further exploring this proposed solution, we will define maturity evolution levels for each one of those components, as follows:

Observer Maturity Levels

1) **Unreliable inputs** [Low Observability Level]

   Data quality issues lead to an overall data inconsistency.

   Due to a lack of Information Architecture, Organisational Agents have no harmonised and common understandings on global informational organisation concepts.

2) **Reliable inputs, Unsuited Decision Support System** [Medium Observability Level]

   Data collection and storage processes guarantee data quality and consistency.

   The outset of Information Architecture in combination with reliable data allows for a common interpretation of information concepts – agents begin to "speak the same language" –.

   Information aggregation in order to support decision-making is unsuited to individual needs.

3) **Reliable inputs, Optimised Decision Support System** [High Observability Level]

   Data and Information Architecture maturity allows for adequate and accurate decision-making processes based on optimised Decision Support Systems.

Modeller Maturity Levels

1) **No business rules and policies** [Low Modeller Level]

   Lack of business rules and policies that guide agents towards overall business goals implementation, which enable for Agent design freedom – Agents create their own modelled "world view" –.

2) **Scarce business rules and policies** [Medium Modeller Level]

   The Organisation establishes a set of business rules and policies in order to guide the implementation of overall goals, thus restricting design freedom of organisational agents.

   Those rules and policies, whilst providing common goals, are adapted to individual agent context and characteristics – each one creates his own mindset –.

3) **Optimised business rules and policies** [High Modeller Level]

   The established set of business rules can be programmed in order to automatically generate possible agent behaviour based on Observed information (inputs). This allows for predicting possible agent action outcomes in near real-time, and significantly reduces agent freedom.

   At this maturity level, *Business Intelligence* is used as a strategic tool in the organisation.

Controller Maturity Levels

Agent action in order to change Organisational variables presents no maturity levels. The performed controlling action is linear and has only one dimension.

This vision of maturity evolution of the Observer, Modeller and Controller components represents the methodological basis of the present thesis, in order to assess the overall Organisation maturity level.

In fact, given our "Bottom-Up" approach, we argue that the overall maturity level of Organisational Use of Information is a combination of its Agents' maturity levels of information use. The maturity analysis will thus be applied at Agent-level, and not on the overall Organisation level.

Furthermore, **combinations of Observer, Modeller and Controller maturity levels define a "point" in the Agent maturity evolution path**.

Since it is impossible to exactly define such a path, given the complexity of the studied domain, the defined evolution paths are in reality "meta-evolution paths" that represent approximate agent evolution paths. We argue that the meta-evolution path is essentially the same for all agents, and that what changes is the action scope.

Designed Solution

Based on the previously defined Observer, Modeller and Controller maturity levels, and drawing a parallel with our summary of Maturity Models considering our topics of interest, we are now able to extend it with the following combinations of Observer, Modeller and Controller maturity levels:

LEVEL 1 – LOW

Observer: **Unreliable inputs**

Modeller: **No business rules and policies**

Controller: Default Maturity Level

LEVEL 2 – MEDIUM

Observer: **Reliable inputs, Unsuited Decision Support System**

Modeller: **Scarce business rules and policies**

Controller: Default Maturity Level

LEVEL 3 – HIGH

Observer: **Reliable inputs, Optimised Decision Support System**

Modeller: **Scarce business rules and policies**

Controller: Default Maturity Level

LEVEL 4 – HIGHEST

Observer: **Reliable inputs, Optimised Decision Support System**

Modeller: **Optimised business rules and policies**

Controller: Default Maturity Level

This effort allows us to confirm that our Maturity Levels definition for the Modeller, Observer and Controller components are accurately aligned with currently published and commonly used Maturity Models.

Building up on the concept that, at a given moment in time, Organisations can present areas at distinct maturity levels of evolution, our design of evolution paths is rooted in the previously studied Focus Area Maturity Model (See Section Business Maturity 5.1). This model provides for a better adaptation to a specific organisation, acknowledging that each company is different and has unique configurations.

We argue that this model provides us an adequate way of representing the incremental improvement of the particular domain of Organisational Use of Information, grasping unique configurations of Observer, Modeller and Controller maturity levels in real-world organisations.

We thus propose a “Focus Area Maturity Model for the functional domain of Information Use in Organisations”, depicted as follows:

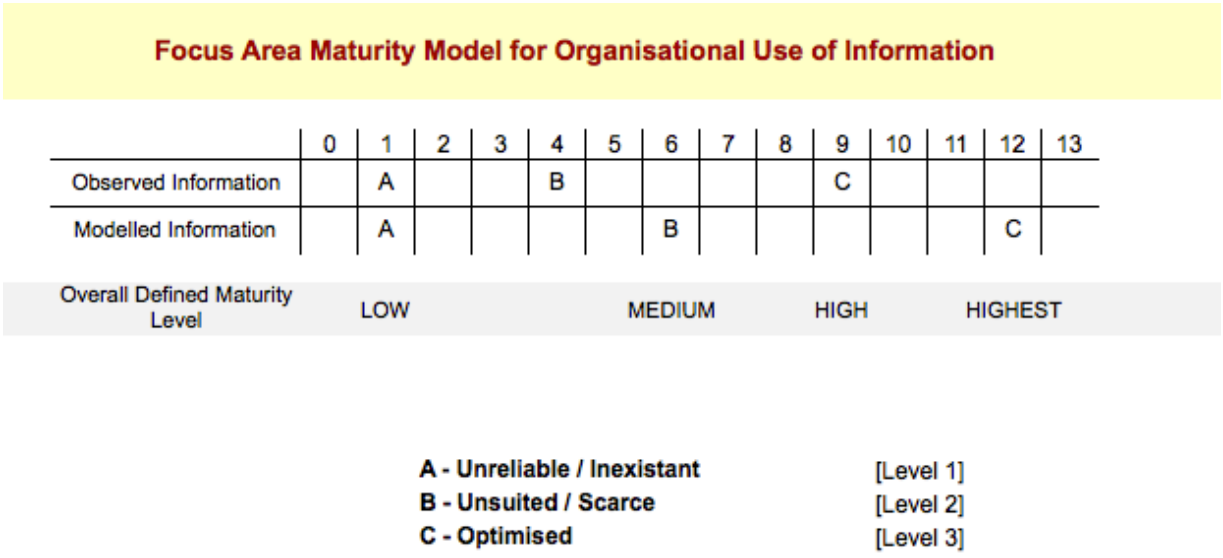

Figure 15 - Focus Area MM for Organisational Use of Information

The “Controller” component is not considered in this model, seeing that it does not present maturity levels – as argued earlier in this section –.

We added to the Focus Area Matrix supplementary information as to where the 4 previously defined overall maturity levels are approximately reached.

The position of the letters in the matrix – defining progressively mature capabilities in the Observer and Modeller domains – indicates the order in which the capabilities of the different components must be addressed and implemented in order to gradually evolve information use in a balanced manner.

The matrix enables to define dependencies between capabilities, where one capability must be implemented after another capability in the same component, as well as dependencies between components, where a capability must be implemented after a capability of another component.

Where to position the letters in the matrix is determined by further research in individual focus area characteristics and particularities [33].

In our case, the letters positioning was determined through all the concrete work done at *Moviflor*, and reflects some of the characteristics of the “Use of Information” Focus Area:

- The sequential steps to follow inside each maturity level are different for each level and from each component.
  (E.g. for the Observer component “Observed Information”, the evolution from capacity A to B is much faster than the evolution from B to C, given the characteristics of said capacities.)

- Similar Capacities in distinct components of the Focus Area are not implemented at similar maturity levels.
  (E.g. Capacity C is implemented much earlier for the Component “Observer” than for the Component “Modeller” – automation of Observer and Modeller –).

It is obviously not reasonable to affirm that the evolution progress inside each maturity level is uniform, seeing that each capability has its own implementation process and stabilisation period. The “steps” inside each maturity level are guiding goals that have to be progressively reached, and this evolution process can greatly diverge in different agent contexts or different organisations.

The defined capabilities’ position in the matrix is thus a preliminary proposal and will eventually be subject to future adjustments, potentially determined by further research and analysis in this field.

In order to provide a better vision of “Evolution Paths” for organisational use of information – as it is the problem we proposed to solve –, we further analyse this Observer and Modeller capabilities evolution.

Hence, based on the “Focus Area Maturity Model for Organisational Use of Information”, we propose a rearranged matrix that provides for a clearer visualisation of said “paths”, as depicted below:

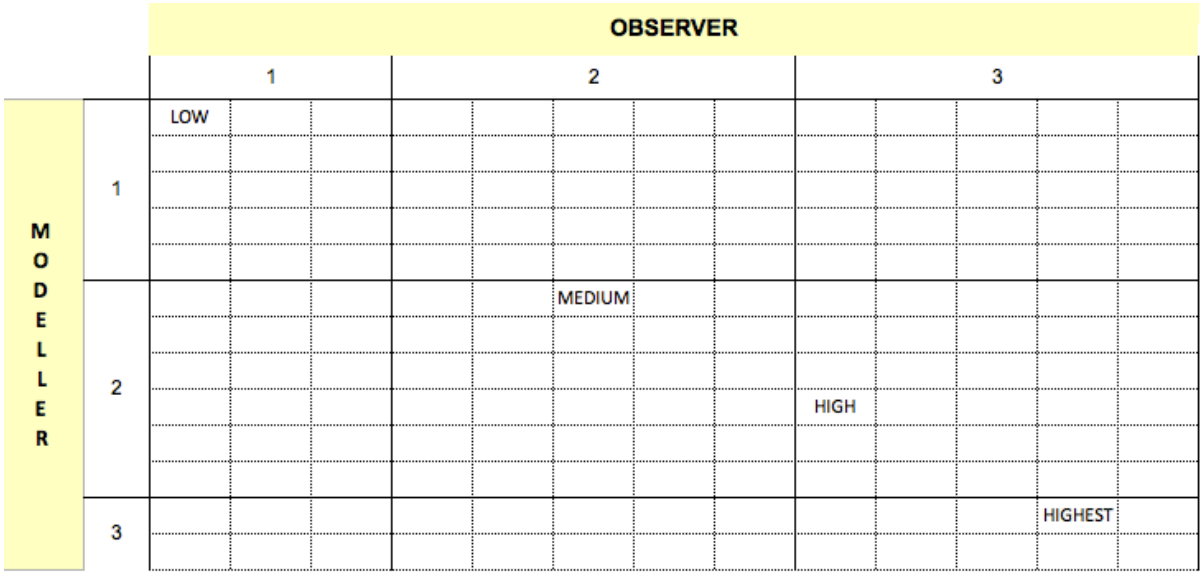

Figure 16 - Evolution Paths for Organisational Use of Information

The Modeller maturity levels (or capabilities) are presented in the matrix rows, whereas the Observer maturity levels (or capabilities) are presented in the matrix columns. Inside each level, the number of "steps" to achieve varies according to previously defined evolution of capabilities in Figure 15.

Additionally, the 4 overall Maturity Levels defined earlier in this section (from Level 1 – LOW to Level 4 – HIGHEST) are positioned in the matrix, in order to provide a better visualisation as to when those generally accepted levels are reached.

In that way, an Agent starting at the position (1, 1) in the matrix will gradually evolve its capabilities reaching progressively higher maturity levels of its Observer and Modeller Components. Each step of the evolution in its Observer component will increase a position vertically – on the columns –, and each step of the evolution in its Modeller component will increase a position horizontally – on the matrix rows –.

As an example, after having navigated along the evolution path over a given period of time, an Organisational Agent could find itself presenting a matrix like the following one:

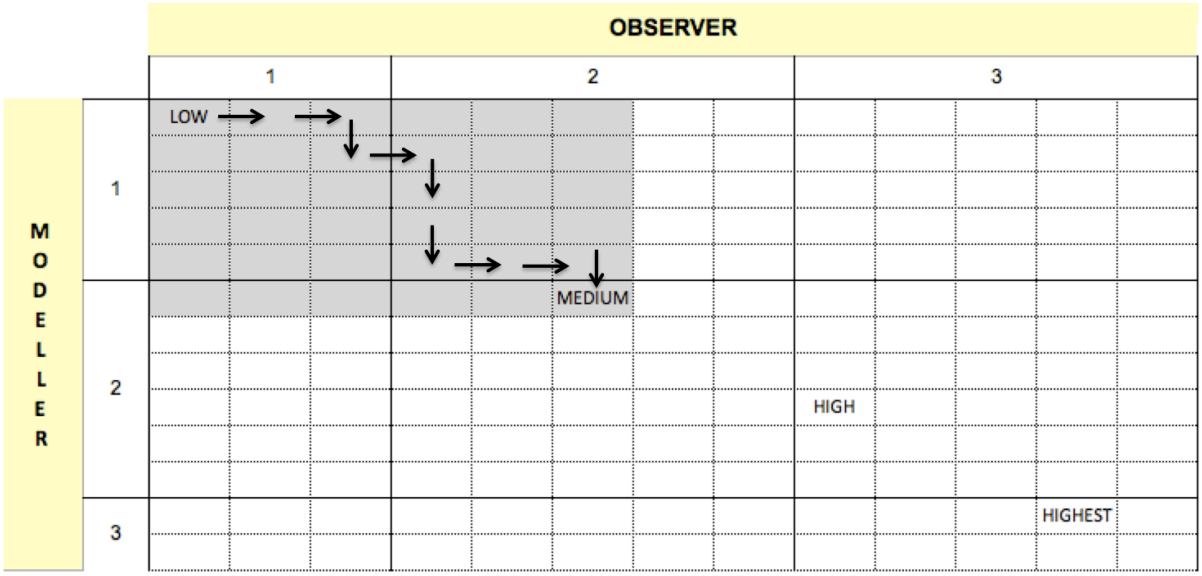

Figure 17 - Example of Evolution Path for Organisational Use of Information

Based on all the theoretical and field research done, we argue that in a given instant, distinct agents in a given organisation can be at different maturity levels, not being at the same "point" in the maturity evolution path.

The leap to Business Intelligence will take place around the position (10, 10), between the Maturity Levels generally designed as "HIGH" and "HIGHEST".

7.4 Validation

In order to validate our design solution and overall assumptions made throughout the present research, a final iteration at *Moviflor* was needed. This iteration consisted of a series of 3 interviews conducted to subjects acting in 3 key areas: Sales, Logistics and Management Group.

The goal of those interviews was to capture the maturity states of different business actors based on our concepts of Modeller, Observer and Controller maturity levels, and further confront them with hypothetic evolution paths – always keeping in mind the previously described concepts of "Agent Decision-Making Feedback Loop" and proposed maturity evolution framework for organisational use of information –.

Sales Validation

This validation was performed with a Store Manager and a Store Assistant Manager, whose daily tasks are mainly of operational management with components of strategic management, related to Client Service and overall Employees, Warehouse and Store Management.

Observer Maturity State

Due to predominantly managerial tasks, information provided to support daily activities is based on SAP ERP listings and panels and, when necessary, manually retrieved ad hoc information in order to obtain more detail.

Some shortcomings of existing information were pointed, like the poor information detail that is sometimes found on said listings and panels, due to data insertion issues "Sometimes the information is not correctly inserted, or is totally missing". Conveying the overall notion that end-users may not use the ERP system as it is intended to, still causing data quality issues.

Some current needs for information were also pointed, like the lack of information on overall store expenses. Partial information on the expenses on store utilities is regularly provided to the store management teams, but is often outdated or incomplete.

Store information (like expenses, stocks, customers) is spread throughout the ERP system (in accounting, stocks and Customer Relationship Management modules) and is not centralised in one place. It is thus impossible for store managers to have an integrated vision and understanding of store budgeting and execution, in order to adequately take actions towards optimisation.

Modeller Maturity State

Given the nature of the Sales area, most of the decision-making processes do not follow predefined business rules or policies, though abiding by general guidelines. Most of the Store Manager daily tasks consist of adaptable and flexible processes, where "each situation is distinct from another".

Those situated decision-making processes, mainly related to Customer Service, call for an extreme adaptability and sensibility, sometimes resulting in a compulsion to bend the rules, seeing that the primary preoccupation is Customer satisfaction.

Confronted with the possibility of a maturity evolution towards automatically generated agent behaviour based on observed inputs and predefined business rules and policies – i.e. Optimised Business Rules and Policies Level –, the consideration was that “even though such tools could exist and would significantly improve overall organisation management, an automatically advised behaviour would have to be carefully analysed and validated, and would probably be frequently disproved, due to the peculiarities of operating in contact with customers”.

Maturity Levels Assessment

The Observer maturity assessment shows that there are no data quality issues, and the inputs are soundly reliable. However, several shortcoming on existing information where pointed, in addition to an obvious issue at Information Architecture level. In fact, Information Architecture seems not to be fully adequate to the Store Managers needs, lacking informational entities concerning the “Store” as a whole, preventing for a common and harmonised understanding of this entity trough the entire Organisation. There is thus no accurate way of obtaining aggregated information on stores that provides for an adequate observation of the “Observer” component of our Feedback Loop.

The Modeller maturity assessment shows that some business rules and policies exist, but are not a restricting force for the agents in this area and context.

The assessment conducts to the following Focus Area Maturity Model:

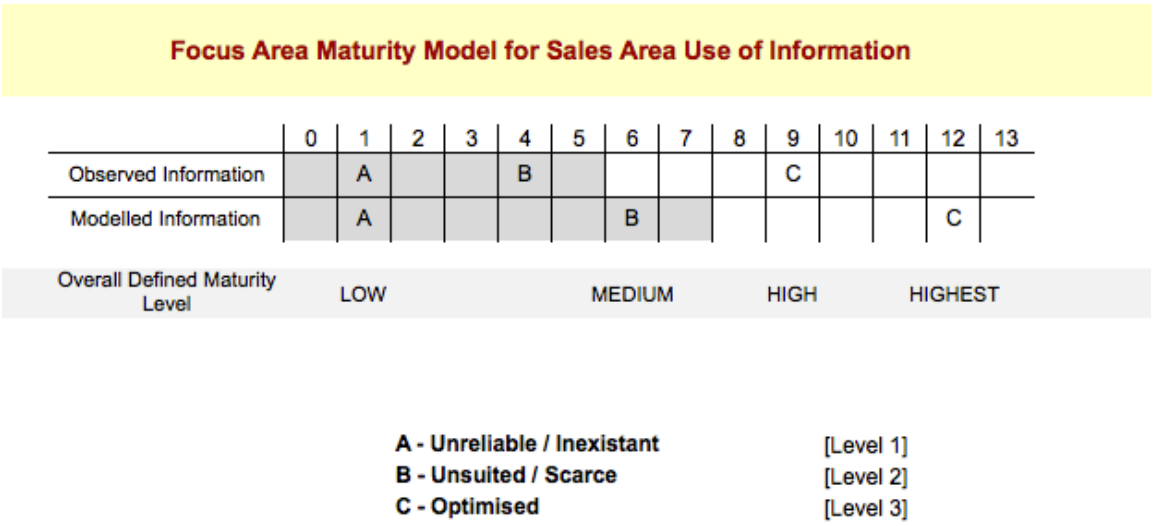

Figure 18 - Validation Focus Area Maturity Model for Sales Area use of Information

Logistics Validation

This validation was performed with a Warehouse Manager, whose daily tasks are mainly of operational management, related to Material Delivery Management, Fleet Management, and Distribution Teams Management.

Observer Maturity State

In order to support daily tasks, the information provided is based on SAP ERP listings and panels and, when necessary, manually retrieved ad hoc information in order to obtain more detail.

Some current needs of information are felt, but do not affect daily tasks: “My informational needs so as to perform my daily tasks are fulfilled, I have all the information I need”. Referred information shortcomings would help supporting seldom-performed tasks, and consist of Schedule Changes in the Suppliers Discharges: such information has to be manually extracted from the SAP ERP system and is often missing, implying for managers to have to contact the Purchasing Department.

Another mentioned shortcoming is the lack of information on the distribution centre expenses, which represents the same situation referred in the Sales Area, related to store expenses information.

Modeller Maturity State

Given the nature of the Logistics area, overall processes and business rules are strictly defined and followed: “All my activities follow predefined norms”. The nature of such area compels to establish a set of business rules and policies in order to restrict agent design freedom.

Maturity Levels Assessment

As seen in the Sales area, the Observer maturity assessment shows that there are no data quality issues, and the inputs are soundly reliable. Likewise, the same Information Architecture issue is present in the Logistics area, but at Warehouse Management level it seems to be the only issue, seeing that overall information needs are satisfied.

The Modeller maturity assessment showed a more mature context, where business rules are strictly followed and guide daily activities.

The assessment conducts to the following Focus Area Maturity Model:

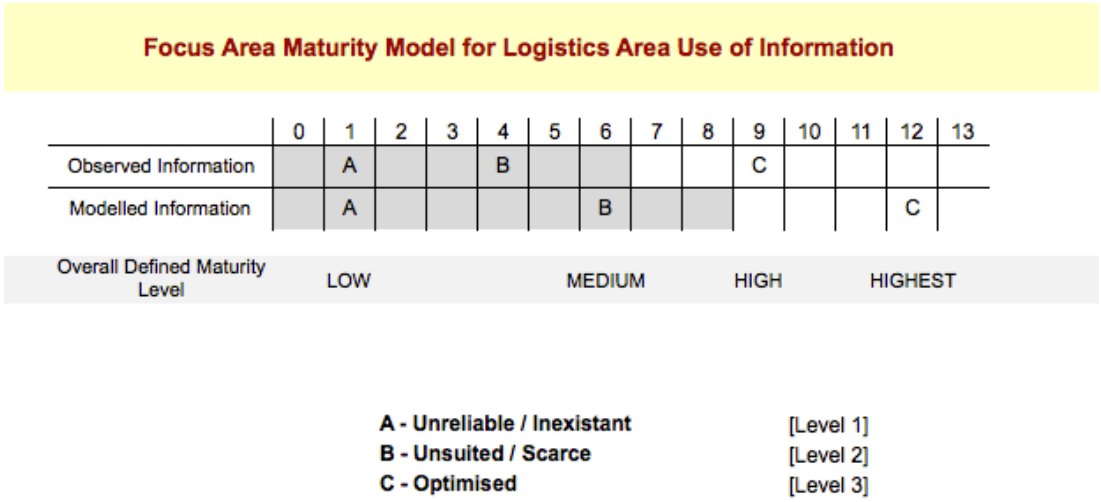

Figure 19 - Validation Focus Area Maturity Model for Logistics Area use of Information

Management Group Validation

This validation was performed with *Moviflor's* Project Manager, qualified to provide an integrated overview of transversal Department Management in the different business areas.

Observer Maturity State

At Management Group level, all Heads of Department are provided with monthly execution reports, manually constructed in order to provide an integrated view of the previous month business execution, adapted to each individual's need. Those reports enable for a monthly business overview and execution follow up, and are still being optimised in order to provide more detailed information.

The SAP ERP system natively provides reports, listings and information panels, but those mainly contain operational execution information of daily business activity, lacking of more strategic information. Hence, agents with more strategic decision-making activities have more informational needs than agents with operational decision-making activities.

The manual production of referred monthly reports is rooted in this informational need and managed to partially fulfil those needs, still lacking an automatic way of producing them: "All areas still have information needs; the SAP Statistics Module is lacking some important information. (…) We still have information needs of 3 kinds: information alerts, summary analysis reports and tools that allow for more sophisticated data analysis for some power users".

An automation effort is being made, trough the creation of tools that will support automatic information aggregation in order to optimise Heads of Departments' decision-making processes, which will ultimately help steering those business departments.

Modeller Maturity State

At Management Group level, the nature of agent activities calls for predefined business rules and policies in order to guide the implementation of overall organisation strategic goals. At this level, individual agents have the power to adapt those rules and policies to their own contexts and characteristics, thus conducting to more agent design freedom.

Maturity Levels Assessment

The maturity assessment shows a more mature context at Management Group level concerning the Observer component; all needed information exists and is optimised to agents needs, presenting an adequate Information Architecture. Those agents are currently aiming at an automated information aggregation process, showing to be at a much more mature level than seen until now.

Maturity assessment concerning the Modeller component equally presents itself at a more mature level, as it was expected considering the greater responsibilities involved at Department Management levels and consequently needed structure and rigor.

The assessment conducts to the following Focus Area Maturity Model:

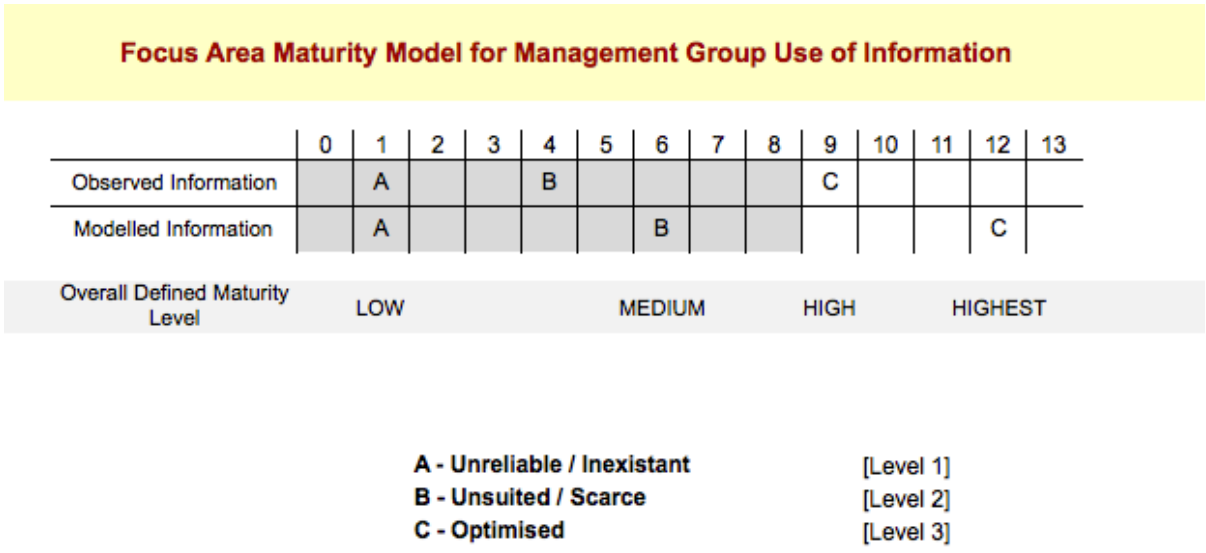

Figure 20 - Validation Focus Area Maturity Model for Management Group use of Information

This Focus Area Maturity Model represents an approximated and synthesised Management Group maturity assessment, as it was not possible to individually assess maturity levels with all Heads of Departments. Our first iteration at *Moviflor* showed us that different Heads of Departments presented characteristics of different maturity levels, and will possibly represent deviations from the assessed Model.

Figure 21 depicts the Sales, Logistics and Management Group assessed maturity levels, each one represented in a different colour in the position that represents its actual “point” in its individual evolution path.

The description of each area evolution paths is a mere example, seeing that the definition of those maturity paths would require a profound historical analysis of each individual area.

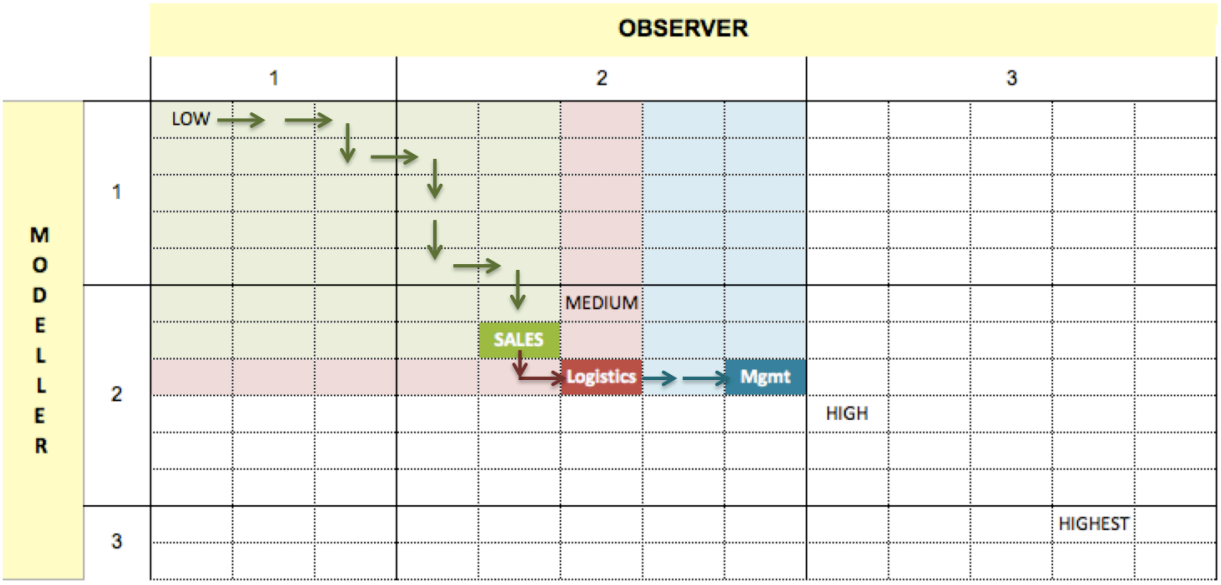

Figure 21 - Validation Evolution Paths

The overall maturity level seems to be around the “MEDIUM” label, being that the Management Group is at a more mature Observer level than the other two studied areas, while the Sales area is at a lower Modeller maturity level than the other two areas.

8 Conclusions and Future Work

8.1 Conclusions

Through the use of a Design Science Research approach, we were able to steer the present research and evolve the initially defined problem towards more realistic goals, by continuously assessing *Moviflor* reality and redefining research concepts.

This thesis evolution led us to more adequate and most important research topics like information use in organisations and the relevance of maturity assessment in order to support organisations management and continuous development and transformation.

Accurate Maturity Assessment of Organisational use of Information revealed itself to be an intricate task, where a series of variables must simultaneously be taken into account. The generally recognised and massively used fixed-level maturity models are an oversimplification of the actual maturity levels existing in real-world organisations, and are unable to fully grasp organisational particularities.

In order to accurately assess maturity levels in our research domain of Organisational Use of Information, we therefore applied the more realistic and customisable approach of Focus Area Maturity Models. In combination with the concepts of Control Theory and Feedback Loops, we were able to define unique agent characteristics and combinations of Observer, Modeller and Controller components, and built upon them in order to define realistic and most approximate near-reality evolution paths. Those evolution paths were presented in a model that allows for a better visualisation of actual maturity level, and enables to grasp an Organisation's evolution readiness in order to confront it to its evolution need – "In many cases, the evolution need is underestimated and the evolution readiness overestimated [16] –.

We were able to identify that agent autonomous actions in their situated environments depend on the inputs taken from the environment and the internal process through which he produces outputs in order to control said environment, so as to meet its design objectives. This ongoing "Feedback Loop", while being apparently identical in all organisational circumstances, produces different outcomes depending on the Agent context and individual particularities, as well as on the corresponding organisational configuration.

In fact, "Feedback Loops" of distinct agents in similar contexts dealing with similar organisational configurations have different outcomes. In its turn, an agent acting on different contexts with similar organisational configurations will present different "Feedback Loops" outcomes, as its Observer and Modeller components are influenced by the different contexts.

This overall vision of agents and their components allows for a further and simplified analysis of such scenarios by cutting trough organisational complexity. Building upon those concepts, we were able to analyse agent maturity and grasp individual needs.

We determined that, whilst acting in the same organisation, some agents had less needs than others, presenting different maturity levels throughout the different business areas, or even in the same business area.

We were finally able to identify approximate maturity levels for the interviewed agents in the validation phase, showing that *Moviflor's* overall Maturity is still at a MEDIUM-LOW level, with its Management Group tending to the be a little more mature in its Information Use.

We can thus conclude, looking back at the initial thesis problem and context, that *Moviflor* is not yet ready to take the leap towards Business Intelligence. The implementation of such intelligent tools can bring mature and experienced Organisations to success, but they have no applicability at *Moviflor's* current maturity level.

8.2 Main Contributions

This research main contribution is to provide a framework to assess Organisational Maturity in its daily use of information and define related maturity evolution paths, by abstracting enterprise complexity trough the use of an "Agent Decision-Making Feedback Loop".

Thanks to this "Feedback Loop" vision, the proposed model enables to determine individual information requirements and needs, Agent by Agent, and define evolution paths – ultimately, towards Business Intelligence –.

This research provided a more detailed awareness on how Organisations have to pilot trough their evolution paths, progressively and adequately gaining capacities and maturity in its information use, by evolving the maturity of its people, IT and processes – abstracted in the Observer, Modeller and Controller components –. The proposed model provides an intuitive tool to easily visualise said maturity evolution paths.

The proposed model provides a framework to answer the initially stated questions:

Q1: Where to evolve, in order to reach our goals?

Q2: How to evolve?

Q3: Who is involved in the Maturity Evolution paths?

8.3 Scope and Limitations

The scope of this research is clearly stated and encompasses the previously defined conclusions and contributions. However, the proposed solution has a major shortcoming: the lack of an accurate and methodological way of defining exact capabilities positioning in the Focus Area Maturity Model for Organisational Use of Information (See Figure 15).

As described in Section 7.3 "Solution Design", the position of the letters defining each component capabilities is determined by a thorough research and field study. The proposed definition of the letter positioning in this research was determined by our experience at *Moviflor*, and lacks of a more accurate and thorough theoretical foundation.

This shortcoming represents the main limitation to the proposed solution.

8.4 Future work

Given the positive validation results, there is a lot of future work to do in order to upgrade and optimise the proposed solution.

As previously described in the “Scope and Limitations” Section, a complete research and study is required in order to acquire new knowledge on Focus Area Maturity Models capabilities evolution, and to define precise Capabilities position in the matrix, as well as exact evolution steps between each progressively mature Capability in the Organisational Use of Information domain.

Additionally, some further research and reflections will be necessary in order to fully understand maturity evolution impacts on distinct Organisational Agents – from “Single-Agents” to more complex compositions of “All-Agents” –

Maturity evolution in the domain of Information Use will most certainly have distinct impacts on distinct Agents, depending on Agent complexity and Organisational maturity:

- Which Agents will feel the bigger impact in case of malfunctions in their “Observer-Modeller-Controller” cycle?

- Which Agents will feel the bigger impact in case of maturity evolution in their “Observer”, “Modeller” and “Controller” components?

And also, which Agents will have a faster and sustained evolution of maturity, given the need to evolve?

Finally, this research leads us to a general question regarding the use of customised engineering solutions – i.e. the use of Focus Area Maturity Models against the use of more global, fixed-level Maturity Models –.

In the present case, this solution provides for a more precise tool to approximate the Organisation reality as much as possible. The benefits of intensive use of customised engineering in the Organisational field are an important reflection topic.

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Appendix A – Interviews and Survey Methodology

1 - First Iteration: Interview Subjects

Head of Information Systems Department	Francisco Pereira
Head of Marketing Department	Eugénia Dias
Head of Operations Department	Luis Fialho
Head of Purchasing Department	Miguel Almeida
Moviflor Project Manager	Pedro Freire

2 - Second Iteration: Survey Subjects

Distribution Centre Director	Marco Duro
Head of Operations Department	Luis Fialho
Senior Receiving Clerk	Mário Rui
Store Assistant Manager	Rogério Nogueira
Store Manager	Sónia Rodrigues
Warehouse Manager	José Américo

3 - Validation: Interview Subjects

Moviflor Project Manager	Pedro Freire
Store Manager	Sónia Rodrigues
Store Assistant Manager	Rogério Nogueira
Warehouse Manager	José Américo

Appendix B – Survey Conducted at Moviflor

Inquérito Dissertação de Mestrado - Moviflor

O presente inquérito enquadra-se num trabalho de Dissertação de Mestrado levado a cabo no seio da Moviflor, que visa estudar o uso de ferramentas de apoio à decisão e de *Business Intelligence* no meio organizacional.

Este pequeno questionário tem como objectivo entender a forma como os colaboradores da Moviflor utilizam a informação que lhes é disponibilizada nas suas tomadas de decisão diárias, bem como as ferramentas que lhes dão suporte.

As perguntas que se seguem focam-se essencialmente em actividades que exijam algum tipo de tomada de decisão por parte do colaborador e no uso da informação que as auxilia.

(Este inquérito é meramente realizado para fins académicos, os resultados recolhidos apenas se destinam a apoiar a investigação em curso.)

*Obrigatório

Funções e Contexto

Essa secção pretende captar o enquadramento do Colaborador na Organização, as suas funções e principais actividades de Tomada de Decisão.

Qual o seu cargo no seio da Moviflor? *

De uma forma geral, as actividades que executa no quadro das suas funções seguem "standards" ou normas pré-definidas? *

(Normas definem directrizes acerca de um produto, serviço ou processo.)

- Nenhuma actividade segue normas pré-definidas
- Algumas actividades seguem normas pré-definidas
- Todas as actividades seguem normas pré-definidas

Que principais funções desempenha no âmbito do seu cargo? *
Por favor listar succintamente um máximo de 10 funções principais.

No quadro das suas funções, como caracteriza a natureza das suas actividades de Tomada de Decisão? *

- Maioritariamente tomadas de decisão individuais
- Maioritariamente tomadas de decisão em colaboração com colegas

- Outra: .....

Informação e Ferramentas

Esta secção pretende captar a forma como o Colaborador utiliza as ferramentas e a informação que tem ao seu dispor.

Que principais ferramentas utiliza para consulta de informação nas suas actividades de apoio à decisão? *

- Sistema SAP
- Word, Excel ou semelhantes
- Listagens ou Documentos físicos
- Outra: ...

A Informação manipulada no quadro das suas funções é apenas utilizada por si ou partilhada com outros colaboradores? *

(Informação partilhada reside em repositórios de informação centralizados e partilhados na Organização)

- Toda a informação manipulada é pessoal e apenas utilizada por mim
- Maioritariamente, a informação manipulada é pessoal e apenas utilizada por mim
- Maioritariamente, a informação é partilhada e utilizada por outros Colaboradores
- Toda a informação é partilhada e utilizada por outros Colaboradores

De uma forma geral, considera que a informação que lhe é disponibilizada através do(s) sistema(s) que utiliza é fiável? *

(A informação poderá ser menos fiável caso haja questões de qualidade de dados)

	1	2	3	4	5	
Informação não é fiável	○	○	○	○	○	Informação é totalmente fiável

É lhe fornecido algum tipo de relatórios/dashboards com informação histórica actualizada e relevante para si, dando-lhe apoio nas suas decisões no quadro das suas funções? *

As suas Necessidades de Informação

Esta secção pretende captar as suas necessidades de informação, no quadro das funções desempenhadas. Caso tivesse essa possibilidade, a que a informação desejaria ter acesso para poder desempenhar as suas funções de forma ideal? (Ex. Listagem dos Produtos em Stock, por ordem de antiguidade em armazém, etc.) Poderá inserir até um máximo de 6 tipos de informação, acompanhados de um pequeno texto descritivo.

Informação 1

Informação 2

Informação 3

Informação 4

Informação 5

Informação 6

Alguma da Informação acima mencionada está actualmente disponível? Se sim, qual? *

Muito obrigada pela sua participação!

Caso deseje, poderá deixar um comentário no espaço abaixo.