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Governing Digital Transformation: Development of a Framework to Monitor Digital Maturity. The Leonardo Case.

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Introduction

Digital transformation has become a primary goal in modern industries. When dealing with the Aerospace and Defence sector which is highly regulated and technologically complex. In particular, the entire sector is characterized by the need of continuous technological innovation while coping with severe security constraints and regulations, long product life cycles and development and usually large company inertia to changes. In this context, we cannot think of digital transformation as simple adoption of new information systems.

We cannot think to achieve such a transformation without having the human resources (HR), also called People & Organisation (P&O), playing a centre role in this evolution. With this perspective, P&O should no more act as a pure administrative support division but as a strategic enabler of organisational transformation. It should become responsible for workforce planning, cultural change, professional growth and data-driven decision-making.

To be able to measure this digital transformation, we need to be able to somehow measure the *digital maturity* (DM) of an enterprise which does not reduce to the knowledge of how many computers or software packages the company has. Digital transformation involves people, processes and culture and therefore establishing its digital maturity is more complex. We therefore need a model which defines a unified framework and language to compare different results from all the company's departments and potentially compare with competitors. Note that a model is not only necessary to have an instantaneous picture of the company digital maturity but also to define a path to follow.

Usually, digital maturity models are found for manufacturing or IT sector of the company where KPI are easier to obtain and measure. The HR division is rarely considered in the digitalization process and in the digital maturity models. Furthermore, when available, digital transformation surveys is HR are mostly qualitative and therefore are hardly useful for quantitative decision-making processes. Moreover, there are almost no studies in the Aerospace & Defence and, in particular, in their HR divisions since, as previously stated, the entire sector is strongly regulated.

The main goal of this thesis is to derive and apply a quantitative framework for estimating and forecasting HR digital maturity in an Aerospace & Defence company.
This thesis originated from my internship experience in Leonardo S.P.A. and more specifically in the HR Transformation Platform team. This team is at the core of the company evolution since it is responsible for coordinating digital transformation initiatives, defining a digital adoption roadmap and developing models for data analysis in support of HR decisions. This is where I was able to gather through internal documentation and interviews the necessary material used in this thesis.
As a first step, it was necessary to obtain a model to assess digital maturity, however such a model was not available and therefore we first found a theoretical and methodological approach to model DM but for the manufacturing sector called DREAMY (De Carolis et al. 2025). We found out that it was possible to build a new model (HR-DREAMY) with the help of the definitions of HR roles by Ulrich (1996) specific for HR based on the same approach by considering HR as a "service factory". In order to apply such a model to assess the current DM level, we first had to extract the necessary information from the available material. We were then able to apply the model and obtain a detailed As-Is (current) picture of the DM for the relevant sub-areas of HR.

As a second fundamental step, we were able to build a framework which allows to predict the change of DM in P&O division due to the adoption of the most relevant HR projects. This was possible thanks to the interviews which allowed us to establish quantitively the impact of each project on the different HR sub-areas. The result is a parametric quantitative To-Be (predicted) model of the HR DM. We achieved a realistic model thanks to the adoption of the *Law of Diminishing Marginal Returns*.
The model was validated through non-parametric statistical tests which supported and enriched the results of the obtained model. Furthermore we verified the robustness of the model throught a extensive sensitivity analysis.

The thesis is divided as follows. Chapter 1 introduces the Aerospace & defence sector together with the brief presentation of the Leonardo S.p.A. company. The literature review on digital transformation, organisational ambidexterity and digital maturity is presented in Chapter 2. The main thesis contributions are reported in Chapters 3 and 4. In particular, Chapter 3 deals with the construction of the HR-DREAMY model in order to measure the As-Is DM of Leonardo's HR. In Chapter 4 we derived the predicted DM values and performed statistical validation of the model, enriched by a sensitivity analysis. Finally, conclusions will highlight the model's limitations and possible future developments and extensions.

Chapter 1 - The Aerospace and Defence Sector and the Leonardo S.p.A. Case

In this chapter we will describe the Aerospace and Defence sector and present the main characteristics of Leonardo S.p.A..

1.1. The Aerospace & Defence sector in the digital era

To understand the meaning of this analysis, we must first clarify the area we are considering. In fact, Aerospace and Defence (A&D) is a world that responds to logic that is really different from that of other markets. We are not in the consumer or automotive sectors, where large volumes and extreme standardisation are the norm. The context can be defined as “low volume for high complexity”, few units are produced but they are of high technological content. This radically changes the perspective that the main strategic asset is not so much the production line itself, but the specialised know-how of the people who work there.

Specifically for this reason, when we talk about digital transformation in this area, we are not talking about simple automation. The challenge is much more subtle and, as confirmed by recent studies on the sector (Kim et al., 2023), the change in digitalization is not automatic, in fact, as we will see in the next chapters, the technological investment translates into business performance only if mediated by strong organisational capabilities (Dynamic Capabilities) and clear leadership.

To complicate more the picture there is the “time conflict” which is the structural friction between the product life cycle and the technology life cycle. A helicopter or defence system is designed to remain operational for 30 or 40 years, this forces the company to develop a culture of stability, obsessive verification and caution. Digital technology, on the other hand, becomes obsolete within two or three years. Integrating these two souls is the real challenge for Organisation Design. Headquarters try to improve digitalization and innovation in a structure that, by its very nature, has been designed to move with caution.

Finally, in this type of company, we encounter the very strict constraints of regulation. National security requirements and military certifications are not just external bureaucracy, but shape the internal architecture of the company. This often imposes restrictions, such as working in silos to protect information, creating a division that is the exact opposite of the transparency and data sharing required by modern digital models. Designing processes in this sector means having to deal with a very rigid perimeter where you cannot simply import the "agile" logic of Big Tech, but must adapt it to a context where compliance and security will always come before pure efficiency.

1.2. The company profile: Leonardo S.p.A.

Leonardo S.p.A. is global company with over 60.000 employees around the world, 60% of which in Italy, 15% in the UK, 13 % in US, 5% in Poland and the rest of the world 6%. In Italy it has about 70 sites, 38 of which are manufacturing/production facilities, located in 15 regions.

The total revenue was 17,8 billion € with a 14% dedicated to R&D expenses. Its sector is the Aerospace, Defence & Security and it operates in areas such as helicopters, electronics, aircraft and aerostructures, space and cyber security. All this data is referred to FY 2024.

Leonardo was born from Finmeccanica as the union of several companies into a "One Company" in 2016. The change was not easy. To fully understand the organisation, we must first illustrate how Leonardo S.p.A. arrived at its current structure. Leonardo has experienced growth that is not often seen in Italian industry, both in terms of size and difficulty. The company that is today is the result of a complex and extensive reorganisation that began in the middle of the last decade. This change transformed a financial holding company such as Finmeccanica into an integrated industrial operating company called Leonardo.

Finmeccanica acted as a corporate "umbrella", controlling a number of companies (AgustaWestland, Alenia Aermacchi, Selex ES, OTO Melara, WASS) which, however, enjoyed substantial autonomy.

These companies were not simply divisions, but independent "kingdoms". Each had its own CEO, its own board of directors, its own financial statements and, crucially for our analysis, its own processes and information systems. An engineer working on helicopters in Cascina Costa and an engineer working on radars in Rome did not share the same tools or, often, the same corporate culture. There was duplication of functions, fragmentation of data and a structural difficulty in creating cross-functional synergies.

The creation of the “One Company” and then the name change to Leonardo aimed at changing this situation, bringing all strategic and operational control under a single centre. As Cristiana Bernardi noted in her study “Leonardo: All that Glitters Is not Gold” (2020), this way of consolidating everything created a gap between what is said at the official level and what actually happens in the field. Bernardi points out that after the merger, the company tried to use new reporting tools to convey the idea of a cohesive company, with a unified value creation that had not yet been realised internally.

The company's organisation works like a system where both the centre and the branches have still a lot of power. On the one hand, we have the Corporate/Headquarters (based mainly in Rome), which acts as the strategic brain. This is where the cross-functional governance functions are located: Group Human Resources, Finance, Strategy and Central Information Technology. This is where I had the pleasure of spending my internship months in the team HR of Transformation Platform. The company's direction is clear. The company wants everything to be done in the same way. The goal is to have the same processes, digital platforms that everyone uses and a simple language within the company. This way, there can be more fluid mobility and exchange of information within the company regardless of the division.

On the other hand, there are the Divisions. The divisions are the driving force behind the entire company and have the technical expertise. They directly follow the contracts with customers, generate revenue and still have a lot of bargaining power given their high level of specialisation, despite formal centralisation. This is because each division has a very specific type of activity. Designing a tiltrotor aircraft follows phases and timelines that are not the same as those required to develop a cyber security solution. This variety in the same company makes people more reluctant to accept rules imposed from above.

Bernardi (2020) says that Leonardo's real problem is not so much about money, but rather the ability to make people within the company understand that they are all part of the same group. When a new digital project is launched from headquarters, those working in the divisions usually experience it as a decision imposed from above. This digital project often seems far from everyday work in the factory. As a result, the corporate spends money on new tools, such as HRIS systems or collaborative platforms. However, the divisions often do not really use them. Old habits die hard, and many still think that their way of working is different from others. This gap between the intention of the centre and the action of the periphery makes the company more resistant to changes in digitalization.

This internal structure faces a market every day where there is no room for errors. Leonardo is consistently among the top 15 global players in the Aerospace, Defence and Security sector, an arena where its competitors include Lockheed Martin, Airbus and Thales. However, the quantitative dimension (billions of euros in orders and different tens of thousands of employees) tells only half of the story. The most important factor in an organisation's processes is who the customer is. Leonardo works mainly with public entities or directly with governments. Its clients are ministries of defence, government agencies and large critical infrastructures. Therefore, every technological choice, even within the company, must comply with security, data control and reliability rules that are not usually seen in other sectors.

This positioning acts as a powerful brake on the digital transformation of processes. Given the confidentiality of the data it handles, Leonardo must ensure that everything always works, without being able to test incomplete and insecure versions of software. This creates a paradox: the company produces futuristic technologies for its customers (e.g. artificial intelligence for drones), but internally it often finds itself having to manage administrative and organisational processes with older tools because they are "validated" and secure. In companies, innovation often does not follow strict rules. Here, compliance outweighs flexibility.

On the one hand, we see that Product Innovation remains managed by the divisions. When it comes to investing in order to improve the performance of a radar or the aerodynamics of an aircraft, the budget is almost always available and the decision is technical, guided by the division's Chief Technology Officer (CTO). Here, the value is immediately visible, tangible and recognised by the market. On the other hand, there is Process and Information Technology (IT) Innovation, which is mainly governed by Corporate. This is where Organisation Design projects, HR platforms, management and collaboration systems come in. For these projects, the approval process is much more cumbersome. Headquarters must gather the requirements of the various divisions, harmonise them (often forcing the issue to find a common denominator) and allocate a centralised budget.

A critical problem that arises in the company digitalization is the strong division between who pays and who uses it. Corporate often launches major cross-functional digitalization initiatives, designed to create the "gold" of integration that Bernardi talked about, but these are perceived in the divisions as foreign bodies. The divisions, seeing no immediate return on their specific business or feeling their operational autonomy threatened, tend to offer "passive resistance" or, in the worst cases, develop DIY (do-it-yourself) solutions thus creating some sort of "Shadow IT", a parallel systems that the corporate wants to eliminate. Moreover, it is very difficult to understand how much these soft projects actually earn. It is easy to understand how much a new numerically controlled machine brings in terms of profit. In fact, it is much more complicated to put a value in euros on a new platform for sharing information or a system for managing performance.

Ultimately, we see that the company moves forward in two different ways. The divisions are able to innovate products quickly. On the other hand, the corporate sector, having to bring the different parts or divisions into agreement, moves more slowly when it comes to updating its internal processes. In my internship, this was one of the most common problems: bringing together different stakeholders who almost always had different requests or observations.

The new CEO has in recent years given a direction in order to improve the company leadership. Leonardo is currently implementing a strategic reorganization within its HR or "People & Organisation" area. The company aims to become a Dual Use-Global Security Company by pursuing a cultural and digital transformation which implies a strategic shift towards developing technologies with both civil and military application (Dual Use). Moreover it wants to move from being a traditional manufacturer to a global provider of integrated security solutions.
Digitalization and the capacity of measuring its impact is becoming a major priority in this new strategic reorganisation.

Chapter 2 – The theoretical framework

This chapter establishes the theoretical framework, based on the available literature, for digital transformation in the Aerospace and Defence (A&D) sector. This transformation should be seen as a cultural evolution which requires Dynamic Capabilities and not just technological upgrades. We explain the tension between innovation and the rigid safety constraints of Complex Product Systems (CoPS). Organizational Ambidexterity is seen as a possible solution to balance efficiency (*exploitation*) with innovation (*exploration*). The bibliographic review also underlines the need to align formal and informal structures to prevent "digital silos". The enforcement of Cybersecurity and "Secure by Design" principles are seen as non-negotiable foundations for the A&D sector. To assess quantitively the company's readiness for this transition there is the need of digital maturity models. A particular model introduced for the manufacturing sector, DREAMY, is first recalled as a diagnostic tool useful to manage companies' structural diversity. Finally, a new definition of success is introduced by rejecting "Lift-and-Shift" approaches in favour of Leading KPIs that measure behavioral adoption and strategic alignment, and real-time monitoring, giving more importance to resilience and compliance with respect to speed.

2.1 Organizational models evolution and the impact of technology

Digital transformation is a process that integrates digital technologies into every aspect of the company and is not just infrastructure restructuring. Operations and culture will have to change, people and processes will have to be involved in order to make the company more agile and efficient. The literature on this subject offers numerous insights. In the article of Schneider and Kokshagina (2021) the authors highlight that digital transformation is not only technological but also cultural. Furthermore, it emphasises the importance of managing the tensions that arise between old organisational structures and new digital requirements, confirming that technology is only the enabler of digital transformation. True transformation is achieved through the development of *Dynamic Capabilities* (Teece 1997), the company's ability to continuously and fluidly readjust and modify its operational processes. The company must continually deconstruct and restructure itself in order to evolve. The technological directives from the headquarters need to aim at a profound behavioural and organisational change capable of absorbing innovation, rather than simply installing software. This theoretical approach needs to represent the direction for the teams dedicated to organisational digital innovation.

The dynamism of digital transformation often clashes with the characteristics of the company's own sector. The A&D companies can only have secure protocols and rigid organisational models and cannot adopt the lean organisational criteria typical of more dynamic sectors as technological industries. The first and more evident constraint arises from the technological complexity of the company products. As Prencipe (2000) writes, the company operates as system integrator which deals with *Complex Product Systems* (CoPS). Unlike service companies or other manufacturing companies, the organisation is obliged to maintain a deep internal technical knowledge (*knowledge depth*) to regulate the integration of heterogeneous and sophisticated technological architectures. The direct implication of this condition is that the company maintains solid and intrinsically complex engineering structures which are also usually rigid. Digitalisation will therefore have to manage and enhance this complexity, ensuring real added value for the operational divisions without compromising engineering rigour. In addition to this factor, the aerospace and defence sector does not respond to the usual laws of supply and demand but is deeply linked to issues of national sovereignty, global security and export geopolitics. Due to the complex architecture of CoPS it is essential to reconfigure the company in such a way that those who design innovation and those who must guarantee its security, can coexist.

As already mentioned, there is a structural problem in the aerospace sector. The engineering solidity required by the systems complexity must be preserved, while at the same time flexibility and innovation must be developed. The solution does not lie in a downward compromise but in the adoption of organisational *ambidexterity*. The theory of O'Reilly III and Tushman (2013) argues that in order to survive and thrive, a company must structure itself to simultaneously execute two seemingly opposite management directives. On the one hand, the organisation must ensure maximum *exploitation*, that is absolute efficiency, reliability and no margin for error, which are clearly fundamental elements for the core production of aircraft and helicopters. On the other hand, it must also pursue constant *exploration* that is risk aptitude and continuous innovation. The analysis by Bilgeri et al. (2017) highlights how the real organisational challenge lies in the integration between IT and the operational side of the business (OP), that is enabling communication between the digital ecosystem and the rigid factory operational line, overcoming natural structural resistance. In this complex strategic architecture highlighted by headquarters, the Transformation Platform team I was part of acts as a corporate connective body. The team dedicated to innovation can be seen as an exploration unit aimed at injecting tangible added value into the engine of exploitation. The company can reduce the gap between engineering rigour and technological innovation only through a balanced approach.

It is important that organisational ambidexterity does not remain a mere theoretical abstraction, but that this duality manifests itself in concrete terms on two fronts: first, externally, by opening up to the market, and second, internally, by changing the culture of daily work. Externally, in order for innovation to happen in practice, traditional corporate boundaries must be overcome. We find evidence of these arguments in a study by Cui et al. (2024), which explains that a complex company must develop a strong *ecosystem orientation* in order to absorb innovation, emphasising that digital transformation does not end at the factory gates but connects the organisation to a global network of ventures and technology partners, ensuring the *organisational resilience* necessary to adapt to the sudden changes of a highly unstable market. On the internal front, however, digital transformation risks being useless unless there is a profound realignment of work dynamics. The analysis by Bonanomi et al. (2020) is interesting in that it highlights the dangerous gap that is created when digital transformation intervenes in corporate habits. The top-down introduction of a new HR platform or management system only affects "*formal structures*". However, if this change is not understood and assimilated, and engineers continue relying on old, established methods in their "*informal structure*", there is the risk of creating "digital silos". Therefore, instead of integrating the organisation, technology ends up fragmenting it. There needs to be a profound evolution in organisational culture to accompany digital transformation.

In the B2C commercial sectors and Big Tech ecosystems, digital innovation can be summed up in the famous motto 'Move fast and break things'. In the aerospace and defence sector, this approach is not applicable and is sometimes a threat to the system itself. The fundamental and constituent aspect is *cybersecurity*. In a very interesting analysis by Möller (2023), it is stated that digitalisation within critical infrastructures only acquires operational validity if governed by the principle of *Secure by Design*. Data protection and network infrastructure integrity must be the first building block of a new platform or organisational process. For a company such as Leonardo, which manages assets that are vital to national security, digital innovation must guarantee absolute impermeability, and cyber security therefore becomes the base upon which the dynamic capabilities of the entire system will be developed. This theoretical framework emphasizes the importance of centralised control processes exercised by headquarters over transformation projects. Any new HR platform, collaborative tool or external connection must pass a rigorous check to ensure that there are no risks for the CoPS managed by the Divisions. The evolution of organisational models within a complex reality such as Leonardo S.p.A. will have protection as an absolute imperative, followed by a search for innovation. The company will always have to balance the friction between a fluid exploration, necessary for the growth of new technologies, and a rigid exploitation that is absolutely secured on the fundamentals of cybersecurity.

2.2 Analysis of Digital Maturity Models (DMM)

In an environment where the need for innovation necessarily coexists with the extremely strict engineering constraints of CoPS: how can you actually measure your *readiness*, i.e., how prepared you are to face and assimilate change? This has led to the creation of Digital Maturity Models (DMMs), analytical tools that can track the starting point and follow the course of the transition. The use of a DMM within a complex company such as Leonardo S.P.A. conflicts with the dualism between the standardisation desired by headquarters and the great desire for autonomy of individual divisions, such as helicopters, electronics or aircraft. Such a complex governance dynamic can be summarized by the concept of "*Structural Diversity*" developed by Sapolsky (1967) which refers to the coexistence, of multiple and different organizational structures, logics, and decision-making systems. In organisations characterised by high structural diversity, the imposition of a single rigid maturity model is ineffective. Therefore, an imposed framework would be perceived negatively and would result in rejection and the raise of barriers. Digital Maturity Models should be seen as sophisticated tools of political and organisational governance. Their purpose is to measure differences so to harmonise them, not to eliminate structural diversity in order to impose a false uniformity.

As we have already seen, Leonardo is a large company with a high level of structural diversity, made up of many long-established sub-companies, the divisions. It is therefore not possible to apply the same digital innovation solution to all divisions, it would be like giving the same treatment for different organs and symptoms. We therefore need a tool capable of making a diagnosis to understand the company's readiness to use the new technology. The chosen diagnostic tool, a thermometer of the company's condition in the field of digital technology, is DREAMY (Digital Readiness Assessment Maturity), developed by De Carolis et al. (2025). This model is multidimensional, thus overcoming divisional logic and not focusing solely on technology as a parameter. DREAMY can simultaneously analyse four fundamental dimensions for the company: Management & Execution, Monitoring & Control, Organisation and Technology. This model is an analytical tool that will be useful in the subsequent stages of the investigation. The framework will be applied to map the current state (As-Is) of the HR area of the digital transformation, as we will see in the next chapter, and in chapter 4, digital transformation projects will be analysed, measuring their impact on the current digital maturity state and allowing the construction of a predicted digital maturity state (To-Be).

2.3 Measuring Success: From Technical to Strategic

After observing the state of the organisation and its readiness through the multidimensional lens of an adapted version of the DREAMY model, it will be necessary to evaluate the success of the initiatives undertaken. To understand the success of digital innovation, it is not enough to rely on traditional accounting KPIs and pure financial Return on Investment (ROI) logic. We cannot act as accountants and count the money or hours saved. The problem of this ineffectiveness is analysed in the study by Mahboub et al. (2003), which draws attention to the famous *Solow Paradox*. Nobel Prize Robert

Solow had already observed that massive investments in IT infrastructure were not immediately and proportionally reflected in production statistics. This was because the wrong things were being measured. This paradox recurs constantly, and many companies fail to demonstrate the success of their transformation because they evaluate new digital ecosystems using outdated lenses. Therefore, it is necessary to not focus solely on cost reduction or the calculation of the man-hour, but to look at the fundamental intangible benefits that digitalisation brings. The success of a new HR platform must go beyond digital technicalities and look at the real benefits. The real added value lies in the tangible evolution of corporate culture, improved collaboration flows and increased organisational agility.

In order to implement a true digital transformation, companies must move beyond the concept of *Lift-and-Shift*, a practise of migrating an exact copy of old processes in the new digital environment, literally lifting and shifting it. Taking an old analogic process and transposing it on new digital tools does not bring any kind of innovation. A study conducted by Schrage et al. (2022) highlights how blindly using the wrong KPIs is the main cause of failure for many digital transformation initiatives and proposes a radical evolution in corporate evaluation methods by introducing the fundamental distinction between *Lagging vs Leading* KPIs. Lagging indicators are retrospective indicators that capture the past, measuring the number of logins to a platform, the number of users trained, and the achievement of technical go-live. These parameters are used for traditional reporting but are inadequate for measuring change. Instead, one should adopt predictive indicators such as leading KPIs designed to measure the speed of assimilation of new processes, the increase in the level of strategic alignment and the improvement in decision-making quality. These will verify whether the project will be a success and therefore whether there is true behavioural adoption, a real change in the way employees work.

In the Aerospace & Defence (A&D) sector, there is a radical difference in the concept of value: the effectiveness of an initiative does not necessarily coincide with the generation of immediate profit or pure speed of execution. In an industry where the margin of error tolerated is almost zero, the true indicators of success are based on three essential aspects:

systemic security, continuity of operations and compliance with strict regulatory standards. These forming what can be defined as *Compliance-driven success*. This conceptual architecture is described in Sürmen et al. (2024), who, analysing applications in the defence sector, confirm that the effectiveness of digital transformation is measured primarily by the ability to maintain the integrity of the system under extreme pressure. With this perspective, the strategy adopted by corporate headquarters and the strict filters imposed on new projects should not be seen as bureaucratic slowdowns, but rather necessary guarantees of resilience. The transformation promoted by the HR and Digital team must inevitably prioritise systemic stability. A technological project that sacrifices security in pursuit of speed of release is not a success, but an unacceptable risk. The evaluation paradigm is therefore shifting categorically towards the principle of *Resilience over Speed*, confirming that the real *added value* of innovation in the defence sector is the capacity creating evolving processes without compromising their reliability.

Annual or quarterly reports cannot be used to control a complex and rapidly changing organisational reality. It is necessary to move beyond these reporting timescales, replacing them with real-time information flows and dynamic, immediate monitoring. A study by Murali and Krishnakumar (2025), initially designed for Industry 4.0 but perfectly adaptable to the digital HR division, shows that the success of an infrastructure is measured precisely through dynamic monitoring systems. We must use digital dashboards to monitor data in real time, as in smart factories. The real goal is achieved when the formal structure (the new software imposed) aligns perfectly with the informal structure (the actual daily behaviour of employees).

In conclusion, all the theories in this chapter and the DREAMY model will be used as guidelines to provide a detailed snapshot of the As-Is (current) situation of the HR digital maturity in Leonardo S.p.A., which we will see in the next chapter, and to design the To-Be (predicted) situation in chapter 4 by evaluating the impact of upcoming digital projects.

Chapter 3 - Digital maturity: from DREAMY to HR-DREAMY

3.1 Introduction

This chapter begins by presenting a digital maturity model developed in the manufacturing sector called DREAMY (Digital Readiness Assessment Maturity). The aim of this chapter is to transform this model so that it can be used in the field of human resources (HR) and obtain the HR-DREAMY framework which is consistent with established maturity-model design guidelines De Bruin (2005).

The model was developed by researchers at the Politecnico di Milano not only to assess the level of digital maturity of manufacturing companies but also to guide towards better levels of digitalisation through a guided path of improvement.

As we saw in the previous chapter, this work fills a gap in the scientific literature since, unlike many currently available models, it does not merely provide a picture of the level of digitalisation at a given moment, but measures readiness (the capacity to adopt digital technologies). The authors of this model also provide a roadmap for companies to follow. In fact, it is precisely the lack of perception and understanding of their own digital capabilities and the lack of clear guidelines for implementation towards digitalisation that leads many companies to have difficulties making this change. Only by having a clear picture of the present (their level of digital maturity) and the future (implementation or improvement plans) can companies tackle this transformation with awareness and a better chance of success.

The DREAMY model is based on solid theoretical foundations and has been validated over a period of five years in approximately 250 companies of various sizes and from different industrial sectors allowing the authors to refine it and collect data for better implementation.

This model offers a comprehensive and systematic analysis of the Digital Dimensions (different key components of digitalisation) of a manufacturing company's processes and organisation.

3.2 The model DREAMY

The development of this model follows four fundamental phases (see Figure 1):

- Model Structure Conceptualisation
- Model development
- Model verification and validation
- Model deployment and maintenance

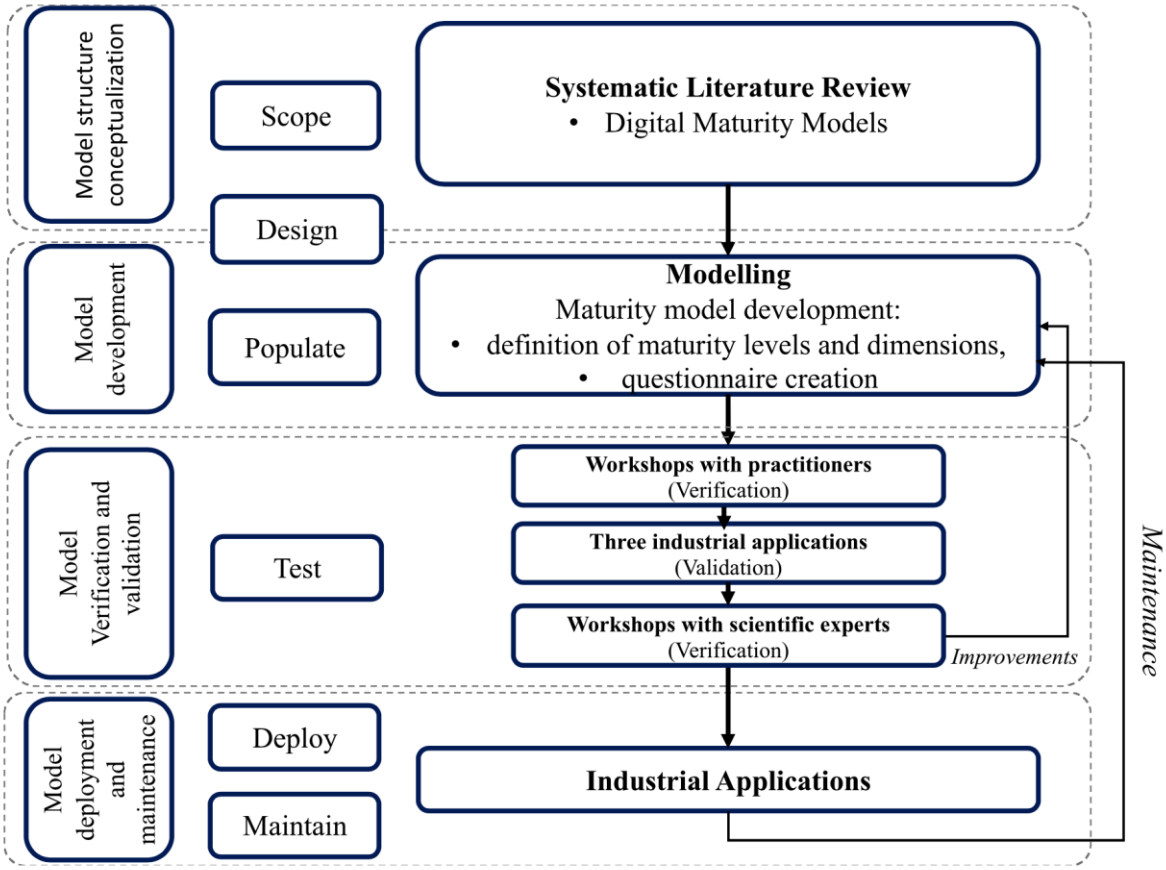

Figure 1: research methodology for the DREAMY model (De Carolis et al. 2025)

The objective of the *Model Structure Conceptualisation* phase is to define the objective of the maturity model and lay the foundations for its development. Through an in-depth analysis of the literature, the authors identify three fundamental aspects. Firstly, it was noted that the application domain of the *Maturity Models* (MM) significantly influences the structure of the MM itself. Secondly, the authors found that the number and definition of *Maturity Levels* were fundamental elements of MMs. Finally, the importance of considering multiple *Dimensions* in MMs was highlighted.

In the second phase, *Model Development*, the guidelines of De Bruin et al. (2005) are followed. Manufacturing companies were identified as the entities of interest (*who*). The model is applied through face-to-face interviews (*how*) to obtain maturity assessment measures (*what*) and ultimately enable companies to understand their level of digital maturity and how to take actions to improve this level (*why*).

During the *Model Verification* phase, workshops were set up with over 50 digital transformation experts to ensure the completeness and accuracy of the questionnaire used in the interviews. For model validation, the questionnaire was submitted to three Italian companies in different production sectors and then evaluated by the managers of those companies. Finally, they interacted with the NIST (National Institute of Standards and Technology) to ensure that the best practices suggested by the model were in line with international standards.

In the fourth and final phase, the model was used by approximately 250 companies from various sectors (food, tobacco, electromechanical, electronics, etc.)- This last phase provided a feedback useful to refine the model itself.

3.2.1 Strategic areas and maturity levels

To ensure that the model is not rigid but can be applied to different types of companies, De Carolis et al. identified five strategic areas common to all companies in the manufacturing sector:

- Design and Engineering
- Production Management
- Quality Management
- Maintenance Management
- Logistics Management

Each of these areas is composed of sub-areas that identify the most common processes in the manufacturing sector. For example, logistics management includes the sub-areas of 'inbound logistics', 'internal logistics' and 'outbound logistics'.

Each area is characterised by a level of Digital Maturity (seen as stages of growth). Specifically, there are five levels, which must possess three fundamental characteristics:

sequentiality over time, irreversible hierarchical progression and a broad range of activities (the transition from one level to another involves a wide range of activities and organisational structures).

Maturity Level Initial (ML1)

The lowest level on the scale represents processes that are poorly controlled or not controlled at all. Reactions only occur in response to a problem, and the solution is not automatically repeatable due to the lack of adequate organisational and technological tools.

Maturity Level Managed (ML2)

Unlike ML1 where there is no planning, i.e., the ability to define in advance how a process should be carried out, in ML2 planning is partial. For example, it is only available for certain projects and is not defined by the company. This level is also characterised by a lack or scarcity of enabling technologies and/or organisation.

Maturity Level Defined (ML3)

At this level, process planning is no longer based on individual intuitions but is regulated at company level through standardised procedures, even if the integration and capacity of systems to exchange data is not complete. Furthermore, there are limitations in process management due to responsibility constraints and a lack of adequate technological tools.

Maturity Level Integrated and Interoperable (ML4)

In ML4, the problems present in the previous level are resolved thanks to standardisation shared within the company. Through the adoption of systems, devices or applications that are able to exchange information and cooperate (interoperability), the process is fully planned and implemented.

Digital-Oriented Maturity Level (ML5)

Thanks to a significant technological infrastructure and organisational capacity with specific attention for growth, the process is digitally oriented. In particular, it involves the integration of multiple operations which improve various aspects such as product development and customer experience.

3.2.2 Dimensions

It is important to remember that quantifying a company's digital maturity cannot be based on a single value or point of view (one dimensional approach). Given the complexity of the processes, it is necessary to take into account various aspects (dimensions).
The four dimensions chosen following an in-depth analysis of the literature are *Management and Execution*, *Monitoring and Control* and *Technology and Organisation*, which will be briefly illustrated below.

Management and Execution
This dimension considers information about how processes are carried out. For example, the following aspects can be considered: how processes are standardised, how they are executed, how information is generated and used, and the level of process integration.

Monitoring and Control
This dimension analyses how processes are monitored and controlled. In particular, the following aspects are considered: process control and measurement, data analysis, decision making, process reconfigurability, and process improvement.

Technology
This dimension includes information regarding the hardware and software tools that support execution and are: system integration, process automation, and data retrieval and storage.

Organisation
This dimension covers information regarding organisational aspects, divided into collaboration, responsibilities and organisational structure.

It should be noted that *Information Technology* is not included among the dimensions selected in the article, as it is incorporated in a separate section called *Digital Backbone*,

which manages all information exchange processes across the various operational areas. In fact, it is the enabling element of digital transformation, as it acts as a backbone, a fundamental part of the body that allows it to move.
In order to obtain the data necessary for the application of the model, a questionnaire was developed for each area, which also includes a Digital Backbone section common to all areas and not subject to ML index evaluation.

3.3 Adaptation Methodology: HR-DREAMY

In this section, we will illustrate how to transform and apply the DREAMY model, described above, to the human resources sector. In fact, although this model is applied to the manufacturing sector, with appropriate modifications, it can be implemented in other sectors.
In this specific case, we consider the entire HR sector as a single company or 'service factory' that takes in people and data and provides services and skills as output.
The proposed model will apply the same Dimensions and ML as DREAMY, while it is necessary to clearly define the correspondence with the areas.

3.3.1 Methodological basis for identifying areas

Traditionally, the function of human resources was evaluated on the basis of the activities it performs (things to do). For example, one might think of evaluating human resources by the number of software licences for generating pay slips or the number of interviews in recruiting conducted. However, this evaluation is not suitable for the DREAMY framework because the processes within the areas would not communicate with each other. Instead, the model introduced by Ulrich (1996) defines HR through its outputs, i.e., the results it generates. With Ulrich's model, we move from "computerisation of the Personnel Department" achieved through investment in IT infrastructure to "digital transformation of human resources". In fact, the aim is no longer to reward the purchase of technology but rather its impact on the business.
In particular, Ulrich introduces the following two-dimensional matrix (shown in Figure 2) and thus identifies four fundamental roles corresponding to each element of the matrix. The first role is that of *Strategic Partner*, corresponding in the matrix to the items Process

and Future/Strategic Focus, which provides an executing strategy as a deliverable, directing HR practices towards the achievement of corporate objectives.
Combining the second element of the matrix corresponding to the items Process and Day-to-day/Operational Focus, identifies the role of *Administrative Expert*, which provides an efficient operational infrastructure as a deliverable.
The third role, *Employee Champion*, arises from the combination of People and Day-to-day/Operational Focus and has as its output the improvement of employee engagement and skills. Finally, combining People and Future/Strategic Focus defines the role of *Change Agent*, which has as its output the creation of an agile organisation capable of adapting quickly to new requirements.

Figure 2: Ulrich roles matrix taken from Ulrich (1996)

3.3.2 Identification of areas

Although the manufacturing sector is very different from human resources, it is possible to identify similarities in macro-areas. This is made possible, in particular, by the size of the considered company (Leonardo S.p.A), which has 15 sub-areas within its HR division: Administration, Compensation, Corporate Culture, Training, HR Business, Partnering, Industrial Relations, International Mobility, Knowledge Management, Organisation, Process Management, Recruiting, Development, Travel Management, Welfare and Workforce Planning.

The sub-areas listed above can be assumed to correspond to the DREAMY processes and will be grouped into clusters. This procedure is a functional metaphor based on the four fundamental roles identified by Urlich.

Cluster 1 - Governance & Strategy

The reference role for this cluster is the Strategic Partner, whose fundamental function is to ensure that the organisation is in line with the corporate strategy. This definition applies to the Quality Management area in the DREAMY manufacturing model. The latter should not be confused with quality control because it is not only dedicated with identifying material defects but also with the quality of the organisation. Following this criterion, the following HR sub-areas are aggregated with outputs corresponding to the role of Strategic Partner:

- HR Business Partnering
- Organisation
- Industrial Relations

Cluster 2 – HR Operations & Administrative Services

This cluster corresponds to the HR Administrative Expert role in Ulrich's model, whose main function is to ensure an efficient infrastructure. In the context of the DREAMY model, this corresponds to the Production Management area, which deals with production planning, scheduling, execution, monitoring and control. The role of HR Administrative Expert and the Production Management area are therefore compatible, making it possible to create the cluster:

- Administration
- Travel Management
- Process Management

Cluster 3 – Employee Sustainment

This cluster in the DREAMY model corresponds to the Maintenance Management area, which deals with maintenance and fault prevention in machinery in the manufacturing sector. When applied to the HR division, the machinery is assimilated to employees, and maintenance corresponds to ensuring that people feel motivated and treated fairly, creating a performance lever. This corresponds perfectly to the role of the Employee Champion in Ulrich's model and gives rise to the cluster consisting of:

- Compensation
- Welfare
- Corporate Culture

Cluster 4 – Human Capital Flow & Development

The creation of this cluster is based on the role of Change Agent in Ulrich's model corresponding to People – Future/Strategic Focus. This role is responsible for transforming the company so that it can adapt to change quickly and efficiently. In human resources, people's skills are the 'product'. In the DREAMY model, there are two areas that correspond to this role. The main objective of the Design & Engineering area is to define product specifications and innovation. In fact, the organisational change defined by the Change Agent corresponds to an evolution of skills and is not achieved instantly through an imposed decision. The second area of DREAMY is Logistics Management, which manages the flow of materials. In HR, this corresponds, for example, to the movement of talents within the company or the recruitment of new talents for faster adaptation to change. The sub-areas present in the cluster are:

- Recruitment
- International mobility
- Workforce Planning
- Training
- Development
- Knowledge Management

Table 1 summarises the four clusters, the HR sub-areas within them, their correspondence with Ulrich's roles and, finally, their correspondence with the DREAMY areas.

Governance & Strategy	HR Business Partnering
	Organisation
	Industrial Relations
HR operations & Administrative Services	Administration
	Travel Management
	Process Management
Employee Sustainment	Compensation
	Welfare
	Corporate Culture
Human Capital Flow & Development	Recruiting
	International Mobility
	Workforce Planning
	Sviluppo
	Formazione
	Knowledge Management

Table 1: The four clusters and their sub-areas in HR-DREAMY

3.3.3 Application of the model

Various data sources were used to assign maturity levels for each dimension and cluster. The main source consists of tables and internal reports prepared during my permanence at the company. I supplemented this data through interviews with colleagues, who provided me with a more complete and in-depth view of human resources at Leonardo.

Note that the data are usually not available as such but need to be extracted from unstructured material.

Table 2 summarises the data collected on the DM levels of each sub-area for each dimension. In addition, the data was averaged to obtain the values corresponding to each previously constructed cluster.

		Management & Execution	Monitoring & Control	Technology	Organisation
Governance & Strategy	HR Business Partnering	2	3	3	2
	Organisation	2	2	3	2
	Industrial Relations	2	2	3	2
		2,00	**2,33**	**3,00**	**2,00**
HR operations & Administrative	Administration	3	2	3	3
	Travel Management	3	3	3	2
	Process Management	2	2	2	2
		2,67	**2,33**	**2,67**	**2,33**
Employee Sustainment	Compensation	2	3	3	3
	Welfare	3	3	4	3
	Corporate Culture	3	1	2	2
		2,67	**2,33**	**3,00**	**2,67**
Human Capital Flow & Development	Recruiting	4	4	4	2
	International Mobility	2	4	3	2
	Workforce Planning	2	4	3	3
	Sviluppo	4	3	3	2
	Formazione	3	4	3	2
	Knowledge Management	3	3	1	2
		3,00	**3,67**	**2,83**	**2,17**
	Total	**2,58**	**2,67**	**2,88**	**2,29**

Table 2: Digital maturity levels in HR-DREAMY

A radar graph is chosen to represent these results (in line with the DREAMY methodology), as it allows for quick understanding since it highlights any asymmetry between the values of the dimensions. We will first carry out a detailed analysis of the results of the averages of the individual clusters. In Figures 3 and 4 the radar graphs for each cluster are shown, while the cumulative digital maturity levels for the entire HR area are represented in Figure 5.

Figure 3: Radar chart for clusters 1 and 2

Figure 4: Radar chart for clusters 3 and 4

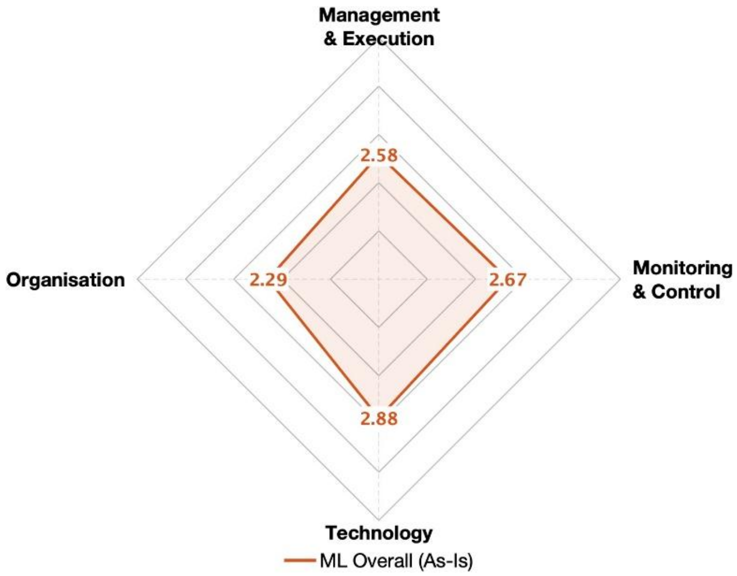

Figure 5: : Radar chart for overall ML

3.3.4 Interpretation of results

The first results we will comment are those relating to the Governance & Strategy cluster. It is immediately evident that the value of the Technology dimension is significantly higher than the others. In fact, Leonardo has acquired and implemented a great deal of technology (hardware and software) in recent years to significantly increase its level of digitalisation. It has invested heavily in *Workday* (a leading cloud platform for business management, specialising in human resources, finance and planning), dashboards and other technologies. However, as Kane et al (2015) pointed out, this is not enough to improve DM which depends on skills and culture and not just on the software itself. The

difference we see in the table between the results of the Technology, Organisation and Management & Execution dimensions is an clear evidence of this aspect.
Although the company has the technology to develop accurate analyses, we can see that the value of the Monitoring & Control dimension is still low. Leonardo still uses 'Descriptive Analysis', i.e. reports based on the past, as defined in the article by Davenport et al (2010), rather than 'Predictive Analysis', which is essential for looking to the future and acting as Ulrich's Strategic Partner.

In the second cluster, HR Operations & Administrative Services, the results are more balanced. The average of 2.5 for the four values indicates that there is a problem in this important area which is also known as the 'HR factory'. A more in-depth analysis shows that the Process Management sub-area lowers the average with a score of 2 in all dimensions, due to the fact that the company does not have an entity who measures and optimises processes, inhibiting progress. In this cluster, we also note that the Technology and Management & Execution values coincide. In fact, Leonardo has implemented platforms such as *Workday* and *SAP Concur* (dashboard for automating and managing expense reports and travel in an integrated manner), allowing processes to be performed digitally without being able to streamline them completely, moving paper-based procedures to digital without simplifying them. The result is a faster but equally complex digital bureaucracy. Marler and Perry (2016) theorise in their article that simply digitising processes without re-engineering them does not create strategic value, as would be the case with the correct implementation of e-HRM (Electronic Human Resource Management). It should be noted that Ulrich's Administrative Expert role, corresponding to this cluster, must ensure operational efficiency through the measurement of continuous KPIs and performance (and not purely descriptive) and therefore needs data from which to process these KPIs. However, in this context, the value of the Monitoring & Control dimension is insufficient, indicating a clear lack of tools for this role. This is an indicator that the company focuses on volume rather than efficiency, as evidenced by the lack of concrete, forward-looking KPIs.

The third cluster, Employee Sustainment, has higher average values than the first two clusters, led by a value of 3 in the Technology dimension. This higher score is mainly due to the Welfare and Compensation sub-areas, which rely on solid external platforms and ERP (Enterprise Resource Planning) modules such as Workday. Despite this, the score is not higher because, being a commodity, it does not currently allow for a sufficient degree of customisation and integration. As we have seen in the previous clusters, there is a '*listening gap*' (the difference between the Monitoring & Control and Technology and between Management & Execution and Technology values) between the data produced and the ability to analyse it, which is an indirect consequence of low customisation. This gap indicates that the role (Employee Champion) corresponding to this cluster is not sufficiently enabled to produce added value.

The fourth and final cluster produces the most interesting and varied results precisely because of the greater number of sub-areas and therefore the larger availability of data. It includes high scores such as 3.67 for the Monitoring & Control dimension and some of the lowest scores such as 2.17 for the Organisation dimension. The higher value of Monitoring & Control derives from Leonardo's industrial context, which focuses on regulatory compliance, security and strict cost control, typical of the Aerospace and Defence sectors. This sector is also characterised by another typical feature, excessive inhibiting bureaucracy, highlighted by the score for the Organisation dimension. In this regard, Bersin et al (2013) define the concept of '*Datafication in HR*' as the transformation of human resources activities based on the use of data (data-driven). However, Bersin also notes that a company with a rigid organisation fails to effectively translate data into improvement strategies; it lacks a '*data mindset*'. Finally, the difference between the Management & Execution and Technology dimensions, with the latter slightly lower, is symptomatic of imperfect interoperability due to the use of different tools within the sub-areas of the cluster. Consequently, a further step is needed to unify the data produced by the individual sub-areas or tools.

After analysing each individual cluster, the analysis focuses on the total values of the dimensions applied to the entire HR function of Leonardo S.p.A., obtained by calculating the average of the DM values of the individual clusters.

The Technology dimension is the most developed; in fact, platforms such as *Workday*, *Sap Concur* and *ServiceNow* (a cloud platform for digitalisation, automation and management used mainly for IT services) have created a solid digital foundation.
The second highest value is that of Monitoring & Control, which, however, hides very different values, such as 3.67 in the Human Capital Flow & Development cluster compared to 2.33 in the other three clusters. The high value in the first cluster derives mainly from the area in which the company operates (Defence), its size and the duration of some projects, which therefore require precise monitoring. The low values in the other three clusters are mainly due to the limited predictive use of data.
The Management & Execution dimension, with a DM value of 2.58, highlights how the HR function is standardising various processes, moving away from a less standardised phase. At this stage, it is important for the company to continue this standardisation with the aim of automating processes without making the company too rigid. This value, which is lower than that of Technology, indicates, as seen above, the risk of creating digital bureaucracy due to the failure to streamline processes during their digitalisation.
The worst value in the DM of the HR area is the Organisation dimension. Leonardo, in addition to being born from a historic company (Finmeccanica), is a company in a rigid sector such as defence. As shown by the DM values presented, the company's skills and culture, due to the combination of various issues related to this dimension, are unable to keep pace with technological investments.
In conclusion, Leonardo's HR has a technological infrastructure that is almost ready for the DM leap, but the organisational culture and inadequate management processes are holding back this improvement.

In the next chapter we will see how current flagship projects are expected to modify the company DM in the next future. This chapter has provided an As-Is picture while the To-Be status will derive from the analysis in the next chapter.

Chapter 4 - HR-DREAMY To-Be

4.1 Introduction

In the previous chapter we derived a picture of the company's present digital maturity with the HR-DREAMY model under the form of an As-Is table which we call from now on HR-DREAMY-As-Is. It is useful and interesting to be able to evaluate the effect of a set of current HR projects on the company HR digital maturity level. In this chapter we will create a predicted digital maturity table HR-DREAMY-To-Be based on the impact of the HR projects. Starting from a list of available current projects, we introduce a procedure for the creation of such table. In particular, we will first select the relevant projects for the HR compartment, then the chosen projects will be associated to the sub-areas which they will affect primarily. In order to differentiate the projects importance, weights will be defined accordingly. Moreover, we also differentiate the weights with respect to the sub-areas to highlight the different impact that each project has on each sub-area.

While building the To-Be table we implement the Law of Diminishing Marginal Returns principle. The resulting data together with the As-Is table will then be analyzed through statistical methods such as Gap-Analysis, Wilcoxon Signed-Rank test, Standard Deviation and Spearman Rank Correlation to obtain significant insight in the role of the selected projects.
Note that, since the information regarding the analyzed projects are internal and being Leonardo S.p.A. primarily a defence oriented company, the data are particularly sensitive and therefore will be anonymised. For example, the names of the projects will be omitted although we will provide a short description without sensitive data.

4.2 Project selection

In the Human Resources (HR) area, the total number of digitalisation projects managed by the team "Transformation Platform", ongoing at the end of 2025 or to be started in

2026, was 72. They were separated into three categories: Flagship (18), Core Roadmap (24) and Supportive (30) depending on the expected impact on the company.

In order to analyze their impact on digitalisation of HR, we have considered only the Flagship ones, the most important ones. Moreover, since not all these were impacting the HR area, three have been excluded and therefore the final number of considered projects is 15. We will first describe each of them in an anonymised description and then establish the sub-areas that are influenced by them.

The connection between a chosen flagship project and the sub-areas has been achieved using internal documentation and direct interviews to the people I have been working with.

Project 1

The project aims at digitalizing the People Review and the Succession Planning processes through redesigning and improving the Internal Mobility process also by using AI to support data-driven decisions.

Project 2

The main objective of this project is the creation of a centralized integrated HR digital archive for all the information regarding employees. This project should completely digitalise employee's documentation to gain operational efficiency and rapid data access.

Project 3

This project aims to improve for a new employee all the necessary steps, from before the formal hiring to the integration to his team. The expected outcome is greater efficiency by the adoption of multiple digital tools and greater engagement.

Project 4

In this project, the company wants to define a simplified competency model aligned with the expectations and behaviours, and accelerate the execution of business plans, obtain strategic alignment and increase engagement.

Project 5

The company wants to accelerate the authorization workflow through analysis and digitalization of the processes with the progressive introduction of AI.

Project 6

The main goal is the definition of more direct and uniform guidelines for roles and mandates in order to obtain a unified governance on responsibilities and roles, and better operative efficiency.

Project 7

The aim is to create the role of Process Architect dedicated to the design and improvement of digitalization processes.

Project 8

This project should coordinate in an integrated way all the initiatives related to health and wellness while ensuring effective communication to employees, measurement of its impact and strategic consistency.

Project 9

In order to promote widespread engagement, this project should develop a tool used by Corporate Culture and HR representatives to reinforce internal dialogue and develop responsible leadership.

Project 10

The company wants to increase its reputation also through an integrated employer branding strategy promoting itself on recruiting platforms and social networks. This will affect the quality of new employees and increase the sense of corporate belonging.

Project 11

This project deals with the creation of a new tool for self-booking which should be integrated with simplified authorization procedure in order to gain efficiency in travel management.

Project 12

The company wants to develop an integrated dashboard with all the data for analysis and monitoring of HR. This system should facilitate data-driven strategic decisions.

Project 13

An application will be created in order to give the user a centralized access with simplified and unified experience to benefit company's services.

Project 14

It is essential for the company to have a widespread adoption of common software tools so that a standardisation is achieved allowing an easier exchange of data and information.

Project 15

Finally, AI based solutions will be implemented in order to facilitate company's documental consultation, thus simplifying the search effort in general and reduce HR requests load.

Since a project can influence more than one sub-area, we have reported in Table 3 the expected impact of each project on the 15 sub-areas.

Project 1	Sviluppo, Recruiting, Workforce Planning, Organisation, International Mobility
Project 2	Administration, Process Management, Knowledge Management
Project 3	Recruiting, Formazione, Sviluppo, Corporate Culture
Project 4	Sviluppo, Corporate Culture, HR Business Partnering, Organisation
Project 5	Process Management, Organisation
Project 6	Process Management, Organisation
Project 7	Process Management, Organisation
Project 8	Welfare, Corporate Culture
Project 9	Corporate Culture, HR Business Partnering, Sviluppo
Project 10	Corporate Culture, Recruiting
Project 11	International Mobility, Process Management, Travel Management
Project 12	HR Business Partnering, Process Management, Workforce Planning
Project 13	Administration, Process Management, Corporate Culture
Project 14	Organisation, Process Management, Knowledge Management
Project 15	HR Business Partnering, Process Management, Knowledge Management

Table 3: Influence of each project of the sub-areas[1]

4.3 Weighting Project Impacts & HR-DREAMY Computation

In order to obtain more reliable data for the computation of the expected Maturity Levels, as a consequence of the application of the selected projects, we have noticed that a further refinement was required. Note that although all projects are defined as "flagship" and

[1] In the table we have shown only the main influenced areas, for Projects 13 and 14 also all the remaining sub-areas are affected but to a lesser extent (see the section relative to the choice of the weights).

therefore have the same importance, their impact on each sub-area is different. As a consequence the impact on each sub-area was assigned a value from 0 to 3:

- 0 if the project has no impact,
- 0.5 when the project will somehow affect all sub-areas, for example when adopting a common software,
- [1, 2) for an indirect impact which indicates that the project is a support tool that does not affect the core of the sub-area,
- [2, 3) if within these values, the project has a strong impact on key processes of the sub-area,
- 3 is given to projects that radically transform the sub-area.

These choices were made, as for the selection of the relevant projects, based on information deriving from my permanence in the company. Due to the qualitative nature of these data (a subjective evaluation) it is important to build a *parametric model* which can adapt to different choices of the weights for future refinements.
A table with the chosen values of the weights is shown in Table 4.

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	Sum
HR Business Partnering	0	0	0	1,5	0	0	0	0	2	0	0	2	0,5	0,5	1,5	8
Organisation	1,5	0	0	2	2,5	3	2	0	0	0	0	0	0,5	2	0	13,5
Industrial Relations	0	0	0	0	0	0	0	0	0	0	0	0	0,5	0,5	0	1
Administration	0	3	0	0	0	0	0	0	0	0	0	0	1,5	0,5	0	5
Travel Management	0	0	0	0	0	0	0	0	0	0	3	0	0,5	0,5	0	4
Process Management	0	2,5	0	0	3	2	3	0	0	0	2	2	2	2,5	2	21
Compensation	0	0	0	0	0	0	0	0	0	0	0	0	0,5	0,5	0	1
Welfare	0	0	0	0	0	0	0	3	0	0	0	0	0,5	0,5	0	4
Corporate Culture	0	0	2,5	2,5	0	0	0	2	3	2	0	0	2,5	0,5	0	15
Recruiting	2,5	0	2	0	0	0	0	0	0	2	0	0	0,5	0,5	0	7,5
International Mobility	1,5	0	0	0	0	0	0	0	0	0	1,5	0	0,5	0,5	0	4
Workforce Planning	2	0	0	0	0	0	0	0	0	0	0	3	0,5	0,5	0	6
Sviluppo	3	0	1,5	3	0	0	0	0	1,5	0	0	0	0,5	0,5	0	10
Formazione	0	0	1,5	0	0	0	0	0	0	0	0	0	0,5	0,5	0	2,5
Knowledge Management	0	2	0	0	0	0	0	0	0	0	0	0	0,5	0,5	3	6

Table 4: the chosen weights

Since multiple projects may affect the same sub-area, we first computed the sum of all the weights relative to each row of the table (column Sum). However, the resulting overall weights show an excessive disparity which does not correspond to reality. In fact, it is known that the benefits of the projects do not sum up in a linear mode for a single sub-area. In particular, as recalled by Mankiw (1998), the *Law of Diminishing Marginal Returns* which states that "the added value generated by each subsequent unit of investment eventually decreases", helps us solve this situation. We first implemented an exponentially saturating function for each sub-area which transforms the rough sum into a *Cumulative Effort Level E* as follows

$$E = E_{max} \times (1 - e^{-\alpha \, \mathrm{Sum}})$$

where:

- E_{max} is the maximum attainable value for the effort level,
- α is a decaying factor and defines how fast the maximum effort level is reached
- Sum is the sum of the project impacts for each sub-area.

In order to choose a reasonable value for the decaying factor α we made the following reasoning. Although theoretically the maximum value for Sum is 45 (maximum impact value 3 x number of projects 15) we have set 21 as a realistic value for the maximum value of Sum which corresponds to our baseline value. Clearly a Sum value of 45 makes no sense since it would mean that all the projects have an impact and all with the same magnitude. Once we have established this value, we chose a value for α so that we obtain a reasonable exponentially decaying function for the effort. The plots in Figure 1 illustrates how the Cumulative Effort varies for three different values of the decaying factor α and shows how very large (the effort is almost the same for all values of Sum) or very low (we do not reach E_{max} value) the values are not meaningful. An α of 0.3 was selected to reflect a significant inertia to improvements since Leonardo is a very large and strongly structured organisation.

We also set E_{max} equal to 3 based on its relation with the maximum allowed increment.

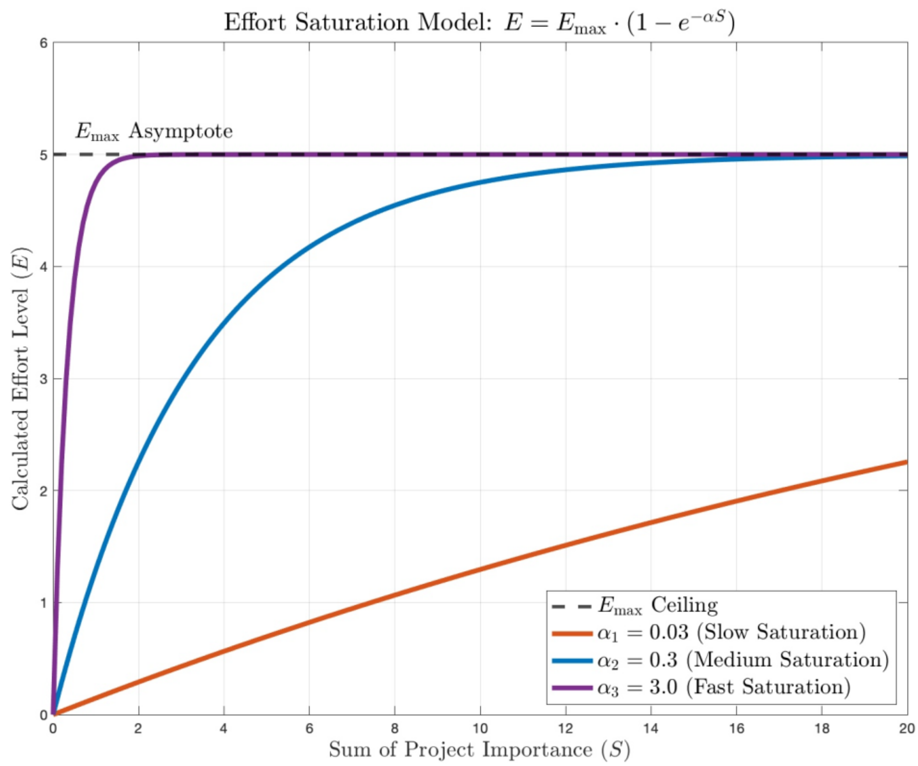

Figure 6: the exponentially decaying added value on the effort

It should also be noted that the increment in the maturity level should decrease as we move from higher As-Is values. For example, it is more difficult to move forward from a maturity level 4 to 5 than from 1 to 2. Again this can be linked to the Law of Diminishing Marginal Returns and therefore we implemented the generation of the increase of the maturity levels due to the projects with the following formula

$$\Delta ML = E \times k \times (CAP - ML_{AsIs})$$

where:

- ΔML is the resulting increase of the maturity level
- E is the effort score which represents how much each sub-area is affected by the projects, its maximum value is E_{max} which we have set to 3
- k is a scaling factor which takes into account the number of levels for the effort score
- CAP is the maximum allowed value for the final To-Be value
- ML_{AsIs} is the initial value of the maturity level in the HR-DREAMY-As-Is table.

We have set CAP = 5 and k = 0.2 so that the maximum value for $k \times (CAP - ML_{AsIs})$ is 1 and therefore the maximum allowed increment is exactly E_{max}.
The resulting HR-DREAMY-To-Be table of maturity levels is reported in Table 5 while the final HR-DREAMY-To-Be table is shown in Table 6.

		Maturity levels increment			
Governance & Strategy	HR Business Partnering	1,64	1,09	1,09	1,64
	Organisation	1,77	1,77	1,18	1,77
	Industrial Relations	0,47	0,47	0,31	0,47
	Cluster 1 average	**1,29**	**1,11**	**0,86**	**1,29**
HR operations & Administrative Services	Administration	0,93	1,40	0,93	0,93
	Travel Management	0,84	0,84	0,84	1,26
	Process Management	1,80	1,80	1,80	1,80
	Cluster 2 average	**1,19**	**1,34**	**1,19**	**1,33**
Employee Sustainment	Compensation	0,47	0,31	0,31	0,31
	Welfare	0,84	0,84	0,42	0,84
	Corporate Culture	1,19	2,37	1,78	1,78
	Cluster 3 average	**0,83**	**1,17**	**0,84**	**0,98**
Human Capital Flow & Development	Recruiting	0,54	0,54	0,54	1,61
	International Mobility	1,26	0,42	0,84	1,26
	Workforce Planning	1,50	0,50	1,00	1,00
	Sviluppo	0,57	1,14	1,14	1,71
	Formazione	0,63	0,32	0,63	0,95
	Knowledge Management	1,00	1,00	2,00	1,50
	Cluster 4 average	**0,92**	**0,65**	**1,03**	**1,34**
	Total maturity increase	**1,06**	**1,07**	**0,98**	**1,23**

Table 5: table of the resulting maturity levels increments

Governance & Strategy	HR Business Partnering	3,64	4,09	4,09	3,64
	Organisation	3,77	3,77	4,18	3,77
	Industrial Relations	2,47	2,47	3,31	2,47
	Cluster 1 average	**3,29**	**3,44**	**3,86**	**3,29**
HR operations & Administrative Services	Administration	3,93	3,40	3,93	3,93
	Travel Management	3,84	3,84	3,84	3,26
	Process Management	3,80	3,80	3,80	3,80
	Cluster 2 average	**3,86**	**3,68**	**3,86**	**3,66**
Employee Sustainment	Compensation	2,47	3,31	3,31	3,31
	Welfare	3,84	3,84	4,42	3,84
	Corporate Culture	4,19	3,37	3,78	3,78
	Cluster 3 average	**3,50**	**3,51**	**3,84**	**3,64**
Human Capital Flow & Development	Recruiting	4,54	4,54	4,54	3,61
	International Mobility	3,26	4,42	3,84	3,26
	Workforce Planning	3,50	4,50	4,00	4,00
	Sviluppo	4,57	4,14	4,14	3,71
	Formazione	3,63	4,32	3,63	2,95
	Knowledge Management	4,00	4,00	3,00	3,50
	Cluster 4 average	**3,92**	**4,32**	**3,86**	**3,51**
	Total	**3,64**	**3,74**	**3,85**	**3,53**

Table 6: final HR-DREAMY-To-Be values

A first quick visual analysis can be performed through the radar charts shown in Figures 7 and 8 which represent for each cluster the comparison between the As-Is and To-Be values. The comparison for the whole company is illustrated in Figure 9.

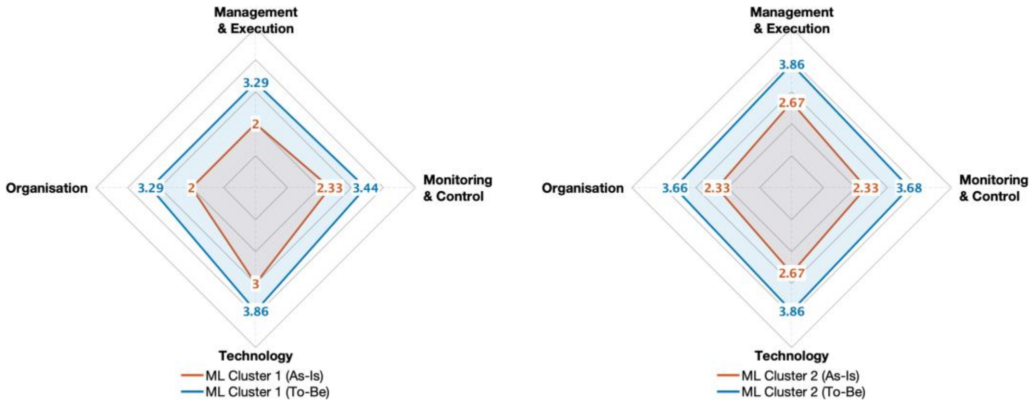

Figure 7: radar charts - cluster 1 and 2, ML comparison between As-Is and To-Be

Figure 8: radar charts - cluster 3 and 4, ML comparison between As-Is and To-Be

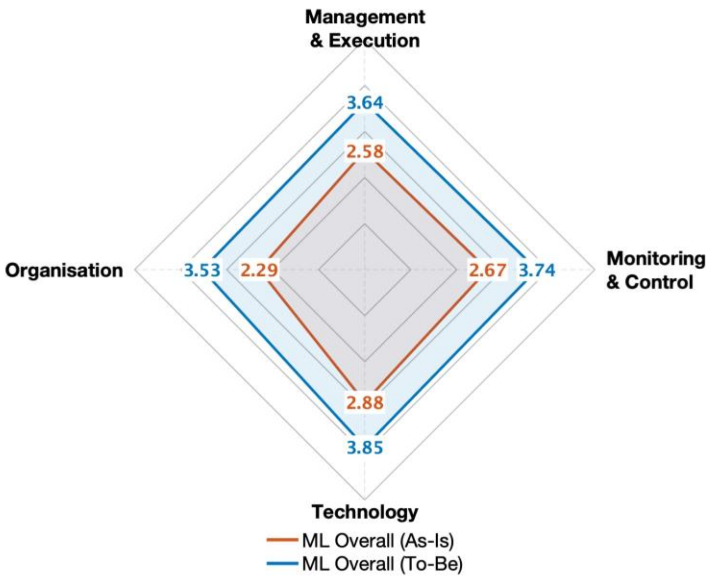

Figure 9: radar chart - overall ML comparison between As-Is and To-Be

4.4 Interpretation of the obtained results

A first comparison can be performed by comparing the average of the overall digital maturity levels between the As-Is and To-Be values. Since this average goes from 2,605 for the As-Is ML to the 3,69 for the To-Be ML, this increase greater than 1 denotes a change of "state" from ML2 to ML3. Moreover, since the value of 3 is far exceeded in all dimensions, the company will have standardized and digitalized the core of all its processes.

We can also perform an analysis on the overall values of the dimensions. The gap between the lowest and highest values, which is still for the same two dimensions Organisation and Technology, has been reduced nearly by 50% from 0.59 to 0.32. The value 3,85 for the dimension Technology is very close to 4 indicating that the different systems are almost interoperable in the sense that they are starting to exchange information and cooperate. On the other side, the weakest dimension in the As-Is ML table was Organisation which, although it remains the one with the lowest value, considerably increased its value arising to the same high half of ML3 than the other dimensions.

It is also interesting to analyse the changes within each cluster. In Cluster 1 (Governance & Strategy) we can observe the more evident catch-up effect on the variations of the sub-areas HR Business Partnering and Organisation which both have increases greater than 1. The highest sub-area increase, in this cluster, is present in the Organisation sub-area and reflects the large number of projects that impact this sub-area. On the contrary the sub-area Industrial Relations has benefited only marginally from the projects. A possible reason lies in the rigidity of the laws which govern trade unions and the scarce effect that digitalization can have in the related processes.

Cluster 2 is the most homogeneous of all clusters with average ML values which range from 3,66 to 3,86. In this cluster, the highest sub-area increase 1,80 is present in the Process Management sub-area and reflects the large number of projects that impact this sub-area (and also all the sub-areas) which goes from ML values of 2 to 3,80. Note however that this increase is not proportional to the high number of the sum of the projects' impacts. This is the effect of having implemented the Diminishing Marginal Return law.

In Cluster 3, we highlight how the sub-area Compensation has benefited only marginally (an average of 0,35) from the projects due to the low impact value 0.5 of the only two projects which affect this sub-area. Also note the highest overall ML increment (Table 3) of 2,37 for the sub-area Corporate Culture in the dimension Monitoring & Control which arises from the lowest initial value of 1 and the high number of the sum of the projects' impacts. This is also the effect of having implemented the Diminishing Marginal Return law.

Cluster 4 hosts the highest score in ML for the sub-area Recruiting which has therefore reached a digitally oriented stage also thanks to the implementation of AI tools. This cluster was the most advanced and remains so with an ML average of 3,90.

As an overall comment from this first basic analysis, we can highlight the general harmonisation of all sub-areas, with realistic improvements and a further improvement of the excellence.

4.5 Statistical analysis

In this section we will support and enrich the previous observations through the use of statistical tools. In particular we have selected Gap Analysis, Spearman Rank Correlation, Wilcoxon Signed-Rank Test and Standard Deviation (Mankiw 1998, Anderson et al. 2014).

The Gap Analysis is a quantitative comparison between the present state (As-Is) and the future estimated one (To-Be). A basic representation of the improvement in the digitalization of each sub-area along each dimension is the heatmap shown in Figure 10. The hot yellow-light green colours indicate a large increment in the ML. Moving from low to high values shows that the projects have bridged the gap. On the opposite, the cold blue-violet colours represent either a refinement of already high ML values (in line with the Diminishing Return Margin law) or the difficulty in improving some sub-areas as Industrial Relations and Compensations.

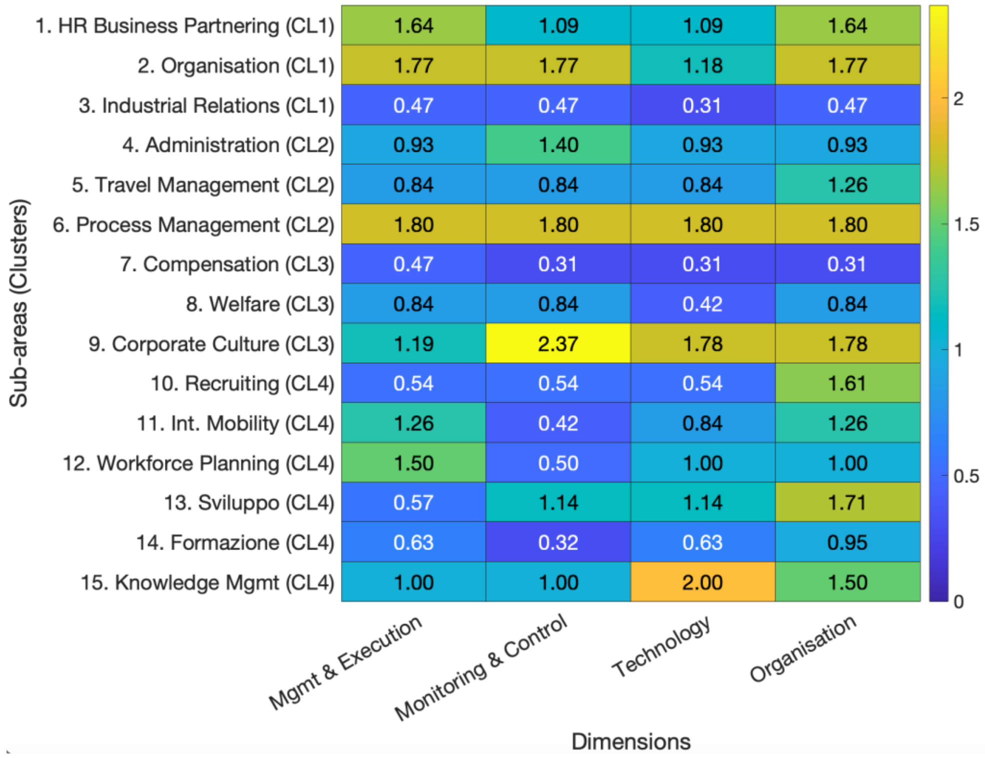

Figure 10: heatmap for the Gap Analysis

As a second statistical analysis we have chosen the Spearman Rank Correlation test which belongs to the non-parametric class. These are mostly useful when there are no hypothesis on the distribution (for example normal distribution) that is it is distribution-free, small number of samples and the presence of outliers. From our two tables, we have obtained $\rho = -0{,}6937$ which supports that the proposed model is coherent with theory and expectations. In particular, it shows a realistic behaviour of diminishing returns by having a strong negative correlation between initial MLs and the expected MLs increase. To illustrate this statistical result, we have generated the scatter plot of Figure 11 where a different colour has been associated to each cluster and the data have been perturbed (jittering effect) to help visualization.

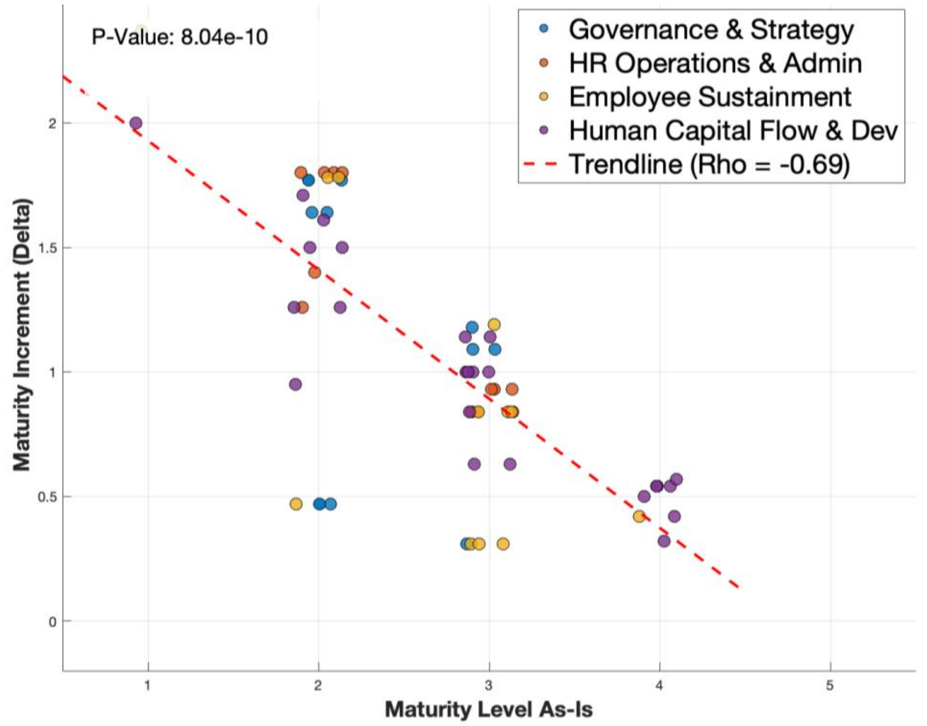

Figure 11: Correlation As-Is vs Increments (Spearman Analysis)

A further interesting statistical perspective is given by the non-parametric Wilcoxon Signed-Rank test which has been chosen so to verify if the implementation of the set of projects determines a variation in the MLs statistically meaningful. The application of this test give a very low P-Value as expected since we are expecting an increase in the MLs. Secondly, the high value of Z-Statistic (6,73) highlights how the change in maturity levels is structural and affects the whole HR compartment. This confirms the effectiveness of the "Catch-Up" and "Refinement" results in line with the company strategy. Note that one could argue that having chosen an additive model (the weights are all non-negative and therefore also the increments are all non-negative) it is obvious that the effects of the projects are all positive as well. However, through the *Effect Size r* we can show that the increments not only are statistically different from noise (P-Value) but these increments are also large since the value of *r* is

$$r = \frac{Z}{\sqrt{N}} \approx 0.87$$

where $N = 60$ is the number of (As-Is, To-Be) pairs. Therefore, we can conclude from a statistical point of view that not only there is a widespread increment in the ML but also that this increment is large.

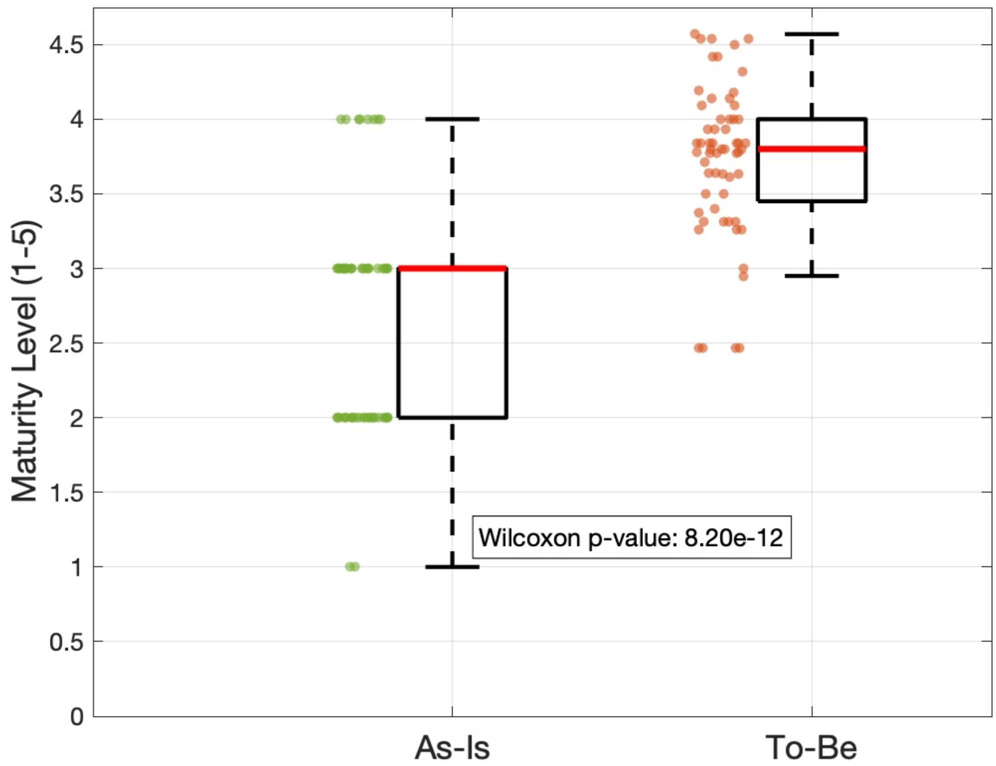

Figure 12: Boxplot for Wilcoxon Signed-Rank test-: As-Is vs To-Be

In Figure 12 we show a comparison between two boxplots, As-Is vs To-Be. The clear reduction of the variance (reduction of the box amplitude) between the two boxplots is the visual confirmation that we will reach harmonisation among the different sub-areas ML and a clear illustration of the Law of Diminishing Marginal Returns. Since the median goes from 3 to 3,8 and, more importantly, the lower end of the box has raised from 2 to approximately 3,5, there is a clear shift upwards of all the ML.

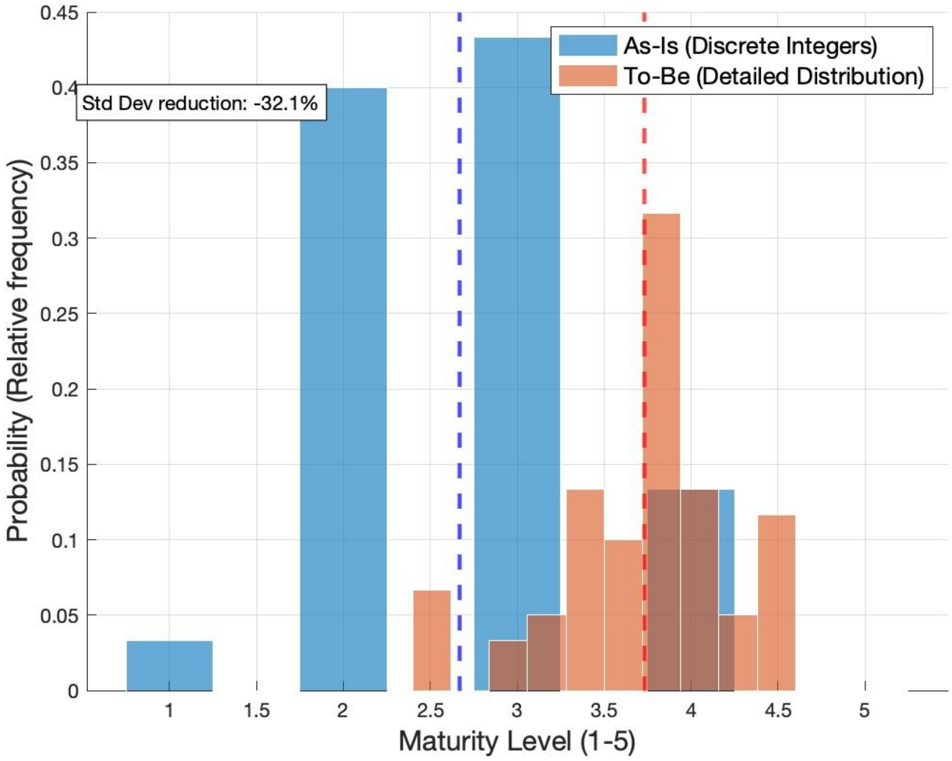

Figure 13: Histogram of the standard deviation As-Is vs To-Be

We performed as fourth and last statistical test a variance analysis. From the resulting histogram shown in Figure 13 we can observe the following facts. The As-Is data shows a large dispersion (from 1 to 4) while the To-Be histogram is more compact which, together with an increase of the mean value from 2,6 to 3,7, again confirms the harmonisation of the ML values. Numerically this is endorsed by the reduction of the standard deviation which drops from 0,75 to 0,51 (a reduction of 32 %). In particular, we can differentiate this result with respect to each dimension as shown in Table 7.

Dimension	As-Is Std	To-Be Std	Delta %
Management & Execution	0,72	0,61	-16,1 %
Monitor & Control	0,92	0,55	-39,8 %
Technology	0,74	0,42	-43,8 %
Organisation	0,46	0,41	-10 %

Table 7: standard deviations for each dimension

From this table, we note that the dimension Technology has the higher standard deviation reduction. We can interpret this result as the objective for Leonardo S.p.A. to align the usage of shared software. On the other end, it is also clear that changing organisation structure is harder than installing software and therefore the dimension Organisation is the most resistant to changes.

We see that all statistical indicators support and enrich the previous analysis done directly by observing the differences between the ML values in the HR-DREAMY-As-Is and HR-DREAMY-To-Be tables.

4.6 Sensitivity analysis of the HR-DREAMY model

The previously derived parametric model HR-DREAMY has been used to generate the To-Be predictions. The two basic steps in this construction were first the definition of the effort value E_s (which depends on the parameter α) for each sub-area s as

$$E_s(\alpha) = E_{max}(1 - e^{-\alpha \, \mathrm{Sum}_s})$$

where Sum_s is the sum of the projects impacts on the sub-area s. The second step was the determination of the increase of the maturity $\Delta ML_{s,d}$ levels given by

$$\Delta ML_{s,d} = E_s(\alpha) \, k \left(CAP - ML_{s,d}^{AsIs}\right)$$

where $ML_{s,d}^{AsIs}$ is the current maturity level of the sub-area s corresponding to the dimension d.

4.6.1 Sensitivity analysis with respect to α

The parameter α is a decaying factor which represents the speed of saturation of the effort value E_s. We have previously chosen a value 0,3 for α so that the decay was realistic. This was not an empirically observed value but rather a reasonable modelling assumption. For this reason, we want to check if the resulting To-Be analysis depends on this specific choice of α or is still valid for different values of this parameter. In other words, we want to test the *robustness* of our model.

We answer this question through the sensitivity with respect to the parameter α analysis. We perform this analysis by allowing a ± 66% variation from the baseline value of 0,3. In particular, we choose the following values

$$\alpha = \{0.1, 0.15, 0.2, 0.25, 0.3, 0.35, 0.4, 0.45, 0.5\}$$

and computed four metrics: (M1) stability of the mean maturity gain, (M2) rank stability of sub-area improvements, (M3) stability of the harmonisation effect and (M4) stability of the bottleneck.

The aim of this sensitivity analysis is not to find an optimal value for the parameter but rather verify if the qualitative conclusions remain robust under parameter variations.

The first metric is defined as

$$\overline{\Delta ML(\alpha)} = mean_{s,d}\left(\Delta_{s,d}(\alpha)\right)$$

where $mean_{s,d}$ indicates the mean over all sub-areas and all dimensions. This metric evaluates if variations in the parameter α have large effect on the overall variation of ML.

The second robustness metric verifies if the sub-area ranking with respect to the maturity levels $\Delta_s(\alpha) = \sum_d \Delta ML_{s,d}(\alpha)$ changes when α varies. The resulting ranking is compared with the baseline case (corresponding to $\alpha = 0.3$) through the Spearman rank correlation coefficient

$$\rho_{rank}(\alpha) = \mathrm{Spearman}(\mathrm{rank}_{\alpha=0.3}, \mathrm{rank}_{\alpha})$$

The third metric evaluates whether the harmonisation that we observed for the baseline case in the To-Be prediction is still present when α changes. This can be measured through the standard deviation of the To-Be levels for a given α, that is

$$\sigma_{ToBe}(\alpha) = \mathrm{std}\left(ML_{s,d}^{ToBe}(\alpha)\right)$$

The final metric indicates which dimension is the bottleneck in terms of digital maturity, that is the dimension which gives the smaller value, for a given α, of the mean with respect to all sub-areas, maturity level. In a formula we have

$$\mathrm{Bottleneck}(\alpha) = \arg\min_d\left(\overline{\mathrm{ML}}_{\mathrm{d}}^{\mathrm{ToBe}}(\alpha)\right)$$

We now report the results for the four metrics.

alpha	Mean Maturity Gain	Spearman Rank Correlation	std reduction %	Bottleneck Dimension
0,1	0,658	0,975	22,52	Organisation
0,15	0,816	0,996	25,19	Organisation
0,2	0,925	0,996	27,67	Organisation
0,25	1,005	0,996	29,98	Organisation
0,3	1,064	1,000	32,10	Organisation
0,35	1,111	1,000	34,04	Organisation
0,4	1,147	1,000	35,83	Organisation
0,45	1,177	0,982	37,48	Organisation
0,5	1,201	0,982	39,02	Organisation

Table 8: robustness metrics results (α variations)

The first metric results, reported in Table 8, show the limited positive variations of $\overline{\Delta ML(\alpha)}$ for the considered interval of α. More specifically, the growth of $\Delta ML(\alpha)$ is smooth (no jumps) and the increase diminishes as α grows. Therefore, robustness is proved since reasonable changes in α produce reasonable changes in the overall magnitude of the improvement and not on its distribution. This aspect will be analysed through the third metric.

The goal of the second metric, the Rank Stability of Sub-area Improvements, is to verify whether changes in α modify the ranking of the sub-areas in terms of the maturity levels increments over all dimensions. Values of the Spearman correlation coefficient $\rho_{rank}(\alpha)$ above 0,9 indicate very high stability in the ranking. In our case, as summarized in Table 8 we have values close to 1 which show that the ranking remains exactly the same. The model is robust in terms of prioritization, changes in α do not distort priorities. Note that for high values of α we have experienced variations in the ranking and therefore this is not a direct consequence of the formulas we have used in the model.

Looking at the results of the third metric shown in Table 8, we first note that we always have a reduction in the standard deviation confirming the harmonisation effect as a consequence of the Law of Diminishing Marginal Returns. Moreover, this effect increases (the reduction increases) as α increases. The results with this metric confirm robustness and in particular changes in α do not change harmonisation.

The results relative of the fourth metric shown in Table 8 show that the dimension that is the weakest independently of α remains Organisation although its digital maturity increases. This may be explained by noticing roles, governance and culture are more difficult to change. Therefore, our model is also robust in terms of the bottleneck metric.

From this sensitivity analysis we can conclude that our model is robust with respect to variations of the speed of the effort saturation α.

4.6.2 Sensitivity analysis with respect to impacts

As a second and more important test we performed a sensitivity analysis with respect to the impact that each project has on every sub-area. These impacts are the most subjective elements in our model and therefore we have created two experiments by adding, with different methods, noise to each impact of the baseline situation shown in Table 4. The random noise is characterised by assuming values in the interval [-0.25, 0.25] with final value in [0, 3] so that a project cannot have a negative impact on a sub-area and its maximum impact is 3 as for the baseline case. In the first experiment this noise is added to each possible (project, sub-area) impact allowing also sub-areas that in the baseline were not affected by any project to have a non-zero impact value. In this way we are considering not only randomness in the mapping values but also in the structure by allowing initially zero impacts to be non-zero. We call this experiment "*full noise experiment*". An example of a randomly generated impact table is shown in the heatmap shown Figure 14.

In a second experiment noise is applied only to the non-zero values of the baseline case. In this way the project/sub-area structure is maintained, only the impact value is uncertain. This experiment is called "*restricted noise experiment*". We consider this second situation as the more realistic one since it is reasonable to assume to know which projects affect which sub-areas while the values of the impact are subjective and thus randomness in this robustness analysis is justified.

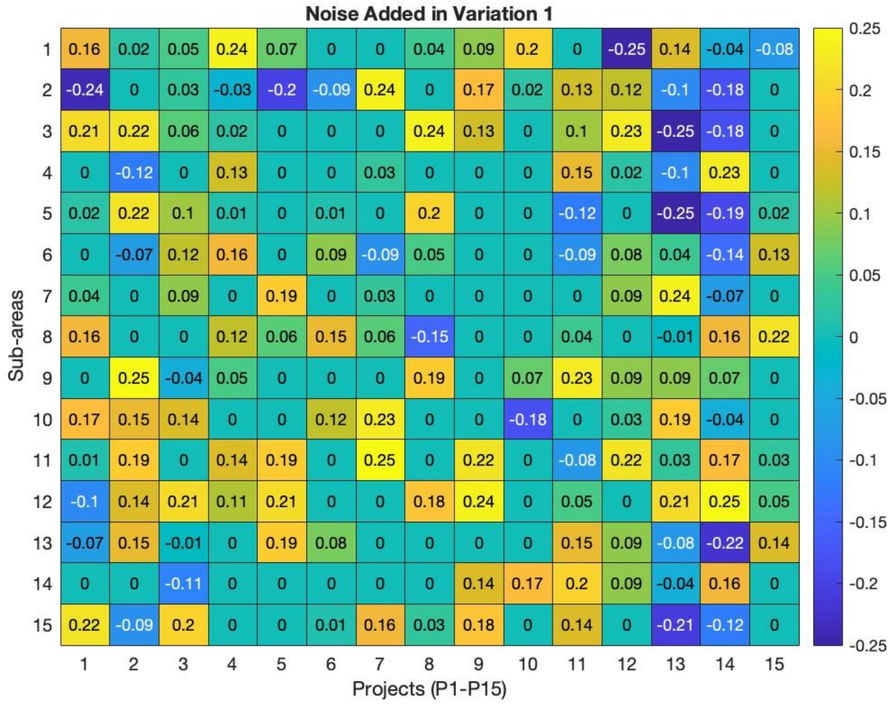

Figure 14: full noise experiment - random noise

For both experiments we did 3000 simulations with these randomly generated impact values and computed the distributions of overall mean ΔML, of Standard Deviations for the To-Be tables and of Spearman correlations. The results are summarized in Table 9 and the distributions are shown in Figure 15 for the partial noise case.

Metric	Baseline	Full noise	Restricted noise	Direction
Mean ΔML	1.064	1.129	1.061	↓
SD (To-Be)	0.497	0.452	0.512	↑
Spearman (As-Is vs Δ)	-0.694	-0.775	-0.697	↓ weaker

Table 9: Impact sensibility - results

The baseline values are characterized by a mean $\Delta ML = 1{,}06$ and a standard deviation in the To-Be values of 0,497.

If we compare the mean ΔML value of the baseline with the two experiments we see that when uncertainty is spread in all sub-areas the mean ΔML increases artificially but

slightly while for the restricted noise case it remains unchanged. From both cases we can state that the baseline increments estimate is robust.
If we concentrate on dispersion, we note that in the full noise scenario we obtain an increased harmonisation which however is artificial. On the other hand, the partial noise experiment displays a minor harmonisation while the structure is preserved. By looking at these results we deduct that harmonisation in our baseline is not forced.
Since the ρ value of the partial noise is practically the same as that of the baseline, the catch-up effect does not depend on how the impacts have been chosen in the baseline but rather it is a property of the model. In the full noise case, since positive noise is added to the baseline 0 values, this creates an artificial improvement and consequently an inflated catch-up.

As a conclusion, all the results show that the baseline model is robust with respect to different variations impact values.

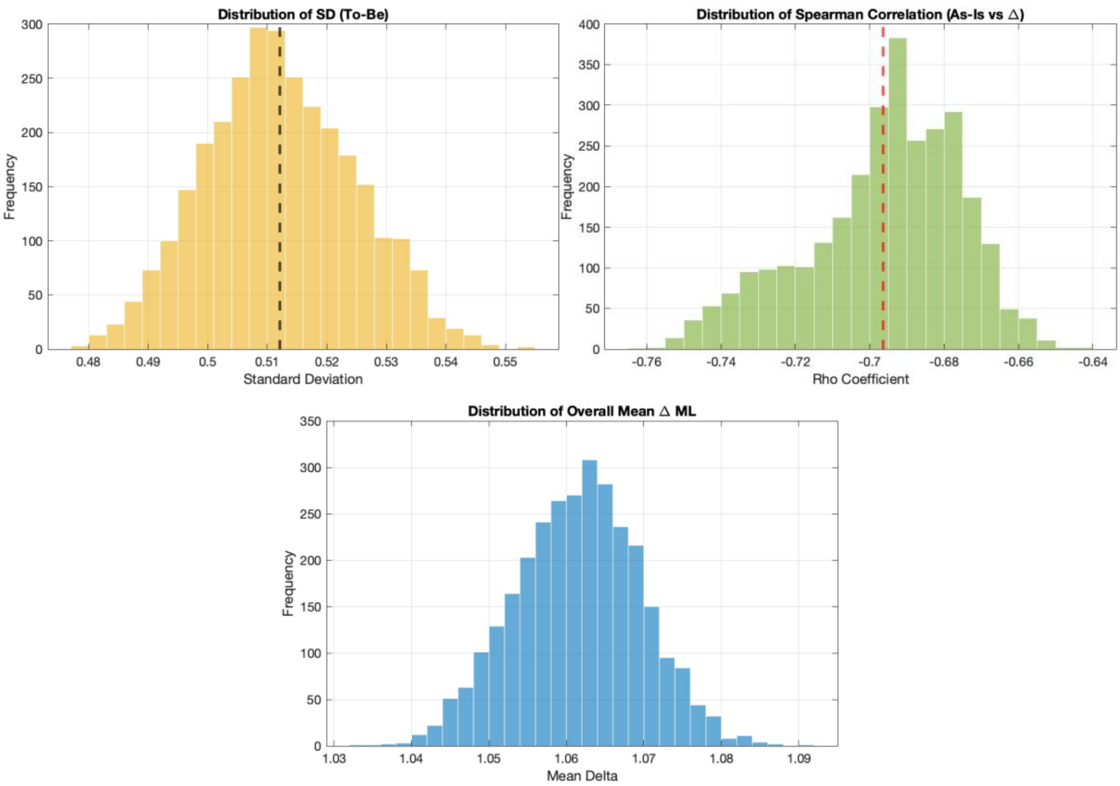

Figure 15: partial noise - the 3 distribution

Conclusions

In this thesis we addressed the problem of assessing digital transformation in the People & Organisation area of Leonardo S.p.A., a large Aerospace & Defence company. Since this transformation is much more than the simple adoption of information technologies, the thesis first focused on a model derivation for determining digital maturity levels in human resources.

We then adapted a digital maturity model called DREAMY, developed for the manufacturing sector, to the HR function and obtained a HR-DREAMY model which was used to evaluate the current state (As-Is) of HR digital maturity. Successively, we extended the model to obtain a predicted scenario (To-Be) based on the expected impact of ongoing and future digital transformation projects. The obtained results showed a clear asymmetry between the technological investments and the organisational capabilities, highlighting that technology alone is not sufficient to enable strategic transformation in HR. The statistically significant To-Be results obtained with the model have exhibited how the company's flagship projects will produce structurally coherent improvements in the HR digital maturity. In particular the model displayed a catch-up effect in the weak sub-areas and a general harmonisation outcome among all the model dimensions. Final non-parametric statistical tests (Gap Analysis, Spearman Rank Correlation, Wilcoxon Signed-Rank test and Variance Analysis) proved that the expected improvements were not only positive by construction but also statistically meaningful. Finally, an extensive sensitivity analysis both with respect to the parameter α and the impacts was performed to show the robustness of our model.

We may identify 3 main theoretical contributions of this thesis.

The first theoretical contributions is the cross-sector adaptation of digital maturity model. We successfully adapted a manufacturing-based model (DREAMY) to the HR sector by considering it as a "service factory". The use of Ulrich's HR roles as an aggregation tool for the HR sub-areas created the necessary bridge between industrial and people management sectors, thus theoretically validating the cross-sector adaptation. We therefore created one of the few digital maturity model (DMM) specific for the HR sector.

As a second theoretical contribution, the thesis formalises the well-known Teece (1997) concept of Dynamic Capabilities and complements established organisational theories of digital transformation such as Schneider and Kokshagina (2021) by introducing multiple dimensions, not only technology, as drivers for this transformation.
The final theoretical contribution was the use of the Law of Diminishing Marginal Returns in the framework of DMM. This allowed us to model the saturation of the "added value" of digital projects over the number of projects. The use of the Law of Diminishing Marginal Return in the model definition has given realistic results and avoided the trap of linear overestimation of the projects' impacts. In our model, digital transformation follows nonlinear dynamics due to the explicit inclusion of diminishing returns, maturity caps and the emergence of catch-up effects and bottlenecks.

In this thesis, we can also identify as a methodological contribution the rigorous quantitative approach to HR digital maturity assessment. This contribution enables and supports the theory. Usually, this sector is characterized by a qualitative approach. In this thesis we defined a mathematical method to compute the current (As-Is) and predicted (To-Be) levels of digital maturity. This approach was validated statistically through 4 non-parametric tests, and its robustness was extensively tested with a sensitivity analysis with respect to the parameter α and, more importantly, the variation of impacts of digital projects.

From a managerial point of view, the thesis gives 3 main contributions.
The model could be used as a predictive tool for strategic planning. It allows to simulate the effect of digitals projects and therefore create scenarios that could be useful for management purposes. In particular in the HR sector, it is difficult to evaluate the ROI of a project, but with this model predictions management can justify the budgets for future projects with quantitative data.
Moreover, the analysis of the model results has shown the existence of a bottleneck in the Organisation dimension that acts as a brake in the digital transformation of HR. In general management can use this model to identify potential bottlenecks and take appropriate measures.

Although the study was based on Leonardo since this framework is modular and parametric it could be adapted to other large and regulated organisations characterized by structural diversity.
As a summary, the model developed in this thesis provides a quantitative decision support tool to guide HR in digital transformation roadmapping.

Being a newly created model, it must still be tested and refined. We did not have the opportunity to test the model as De Carolis et al. did for DREAMY, which was applied to over 250 companies.
It could be useful to further investigate how the choice of which sub-areas a project influences affects the model. Moreover more detailed modelling could increase the prediction precision of the results.
The To-Be results are only a prediction, they cannot capture employee perception, unexpected resistance, shadow IT or governance issues and therefore the resulting digital maturity levels are not certain. However, the model can constitute an effective tool to quantify the potential effect of digitalisation projects.

Hopefully one day this model could be adopted, enriched and refined by the Transformation Platform team.

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