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Digital Transformation Business Development in a Start-up

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Abstract

The digital transformation associated with Industry 4.0's emergence has enabled companies to be more apt in overcoming the resulting new challenges. Although companies are starting to perceive this as a real concern to effectively move business forward in the future, most of them do not know how to operationalise it.

This work project aims to study the overall environment of a small digital start-up, as a way to fit its services to the market, as well as develop a digital maturity assessment prototype tool in order to evaluate the digital maturity of companies and introduce possible solutions to increase it.

Keywords: Digital Transformation, Industry 4.0, Digital Maturity Assessment, Assessment Models.

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“Faz porque queres e sentes, não porque deves e tens”

Sam The Kid

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1. Introduction

The world has been preparing itself for the current ongoing fourth industrial revolution, which is driven by technology and data. This revolution starts with the primordial moment that a company gets acquainted with all the topics related to the Industry 4.0, while it ventures to the more complex creation of, for instance, manufacturing systems that in the physical world are interconnected and able to communicate, as well as analyse data, making the best use of it in order to trigger more intelligent and optimised actions.

Big companies such as Accenture (who leads the digital business), IBM and Deloitte have been developing digital transformation consulting services as a way to help different businesses and industries of all kinds and sizes to get ready for the trends that are shaping their environment. In a much smaller case and in an embryonic state, Invicta Digital, a small start-up focused on Digital Marketing and Website Design services (with the goal to escalate into Digital Transformation services) created the perfect conditions for an internship with the aim to develop a digital transformation business.

The internship started in February 2020 and later that month Invicta Digital turned into a new company called Nexuscorp (also referred in this thesis as Nexus) that is now focused on, not only the services previously mentioned, but also on other areas related to the current Industry 4.0, focusing on delivering solutions in the overall Digital Transformation environment.

The objective of the internship in relation to this thesis (considering that other activities were performed out of the scope of this work project) was to, first, perceive Nexuscorp's internal and external environment to attain a product market fit which would best suit the new business ambitions and the market's needs. Secondly, and most importantly, there was a need to develop a methodology to approach companies and evaluate their digital maturity in order

to deploy the new future services. With this in mind, a digital maturity assessment model prototype was developed and tested in order to address this second objective.

2. Literature Review

2.1. Digital Transformation

With the aim to prepare for the Industry 4.0 revolution, some companies are planning ahead by changing the way they do business. But how can this be achieved?

According to Deloitte's definition, Digital Transformation happens when the application of technology is put in place as a means to radically improve the performance or reach of an organisation, enabling it to improve processes, create new business models and come up with engaged talent (Deloitte, 2018). Although it sounds as a straightforward process that can be achieved by mastering technologies, companies must understand that the whole value relies on their ability to convey the benefits of these technologies for the future of the organisation as a whole.

Digital disruption is already happening in most industries and people are starting to recognise it (Christensen, Raynor, Rory, & McDonald, 2015). The main issue lies on the fact that most of these companies that become aware of digital disruption are not taking the necessary actions to respond to it. Research conducted by the authors of the book *The Technology Fallacy* partnering with MIT Sloan Management Review and Deloitte on how technology changes the way companies operate, indicated that 87% of the respondents interviewed were aware of their industry's disruption by digital transformation, but only 44% of the employees interviewed stated that their companies were doing enough to keep up with that acknowledgement (Kane, Philips, Copulsky, & Andrus, 2019). So, there is a clear gap between knowledge and action which can be explained by the normal tendency of companies to underestimate the threat that digital disruption brings, and the need to quickly act on it.

2.2. Digital Transformation Pre-Requisites

In order to implement a leading-edge strategy that aims to attain significant digital transformation, there are some specific conditions (here stated as pre-requisites) that need to be put in place for the company to be successful in this undertaking.

First and foremost, there is **culture**, which is one of the most important pillars for digital transformation to happen. If companies build an overall culture of change from within and allow for risk-taking to be viewed as the cultural norm, the implementation of new technologies and different business processes can be executed in a more straightforward and painless manner. In order to achieve tangible results, it is required of companies to align their culture, people, tasks and structure, as well as keeping employees invested while technology evolves (Deloitte, 2019).

Keeping the previous point in mind, it is of essence to acknowledge that **people** are key for digital transformation to occur. Without having every employee on board with the correct mindset and with the required skills, digital transformation simply cannot be achieved. According to a study developed by Roland Berger where 505 companies were interviewed, the top three main challenges for digital transformation were: resistance to change, lack of competences and lack of trust from management; all three related to people (Appendix 1). So, not only does top management need to equip employees with the appropriate individual skills, but also need to find ways to motivate them, creating the proper environment to achieve better results, while continuing to keep the competitive edge.

In order to properly set up the first two aforementioned pre-requisites, another extremely important aspect must be present as well, this being **effective leadership**. The path to initially cultivate the right conditions coupled with a strong acceptance culture in order to integrate digital adoption with different digital tools and processes, is through effective leadership. For this specific case, it is the one that can put forth inspiring and powerful

questions, as well as, modelling continuous learning, as a means to getting their companies to the forefront of digitalization. According to Kane et al. (2019), there are some core leadership skills that a good leader has to possess (e.g. direction to provide vision and purpose; inspirational leadership, innovation, talent building, influence, collaboration, etc.), but while in a digitally maturing setting, additional leadership skills are required, for instance managing networks.

Finally, the last but not least important aspect to have in mind before embarking on a digital transformation process is to understand that **strategy** comes before technology. That same type of leader mentioned above will also need to have a truly well-defined digital strategy, focusing on technologies but firstly making sure that there will be prior investment in the company's capabilities that will ensure those same technologies' impact in the organisation as a whole. The company has to define a holistic strategy of what it wants to achieve, how it is going to be implemented, while at the same time accounting for both short-term and long-term realistic goals/outcomes before the implementation phase. This constitutes a crucial component for digital transformation and will most definitely determine the digital maturity of the company (Tabrizi, Lam, Girard, & Irvin, 2019).

2.3. Digital Maturity and Assessment Models

Depending on the effort that a given company invests towards the goal of becoming digital, it can be considered more or less mature in this respect. An organisation that has been investing for several years in its culture, followed up by technology investments to accommodate for the new digital challenges, and is willing to face them, is a company that is digitally maturing. In contrast, a firm that ignores the urge to transform and become digitally adapted is quite distant from being digitally maturing and puts itself at risk. This can result in the possibility of becoming redundant and going out of business, depending on the particular activity and type of business. According to Gerald Kane, digital maturity is a constantly moving

target as technology itself evolves. Thus, a company is never matured, even if it is the most digitally advanced company in the world, since digital maturity is a process that is continuously evolving (Kane et al., 2019). The following digital maturity elements must be kept in mind when trying to digitally transform:

- Maturity is a process that is continuous and gradual while it unfolds overtime
- Gradual maturation should not be confused with less important changes
- A company may not completely know what or how it will ultimately look like when it begins the maturing process
- Maturation is a natural process, although it won't happen automatically
- Maturity is never complete

Moving towards digital maturity might sound as an overcomplicated process and difficult to achieve, but once putting the right effort in place, brilliant outcomes can arise from it, both internally and externally to the company. A study developed by Roland Berger alongside Google Europe regarding the digital maturity of French firms, indicated that the companies that were more mature had a revenue rate six-fold the rate of their less digitally mature respective competitors. Furthermore, those same companies that were more digitally mature also reported an index of well-being at work that was 50% higher when compared to the less mature ones (Bouée, 2015).

But how can a company perceive how digitally mature it is? Several models have been created to assess this specific topic. Most of them try to evaluate the company on different dimensions and end up assessing the digital maturity into different stages for each dimension, which vary as well, depending on each model. The following section will describe briefly three of the most relevant models regarding this subject.

The first most relevant model is by **Acatech – Industrie 4.0 Maturity Index** (Schuh, Anderl, Gausemeier, ten Hompel, & Wahlster, 2017) and it is based on three different phases,

the first one being the “Identification of Current Maturity” stage, based on four distinct dimensions (Resources, Information systems, Organisational structure and Culture) (Appendix 2). It is conducted on site at the firm through a multi-choice questionnaire associated to the six development stages (from the less to the more digitally mature stage: Computerisation, Connectivity, Visibility, Transparency, Predictive Capability and Adaptability). This questionnaire takes place within the company itself and once each participant completes it, the scores for each dimension are aggregated and shown as a concentric circle. Next follows the second phase, the “Identification of capabilities requiring development” where the average maturity stage is perceived as well as the areas that need development. Finally, during the third phase called “Measures” the company can start to develop a roadmap and implement the appropriate measures as soon as possible. This model focuses on the idea of first achieving maturity stage consistency and only then moving on to a higher stage.

The second model is **IMPULS – Industrie 4.0 Readiness** (Lichtblau, Stich, Bertenrath, Blum, Bleider, Millack, Schmitt, Schmitz, & Schroter., 2015) developed for the mechanical engineering industry. It is based on an online questionnaire which, similarly to the previous model, is aligned with six different dimensions of industry 4.0 (Strategy And Organisation, Smart Factory, Smart Operations, Smart Products, Data-Driven Services and Employees) which then subdivides into eighteen more detailed sub-dimensions (Appendix 3). In this case, six possible levels of digital maturity are assessed (Outsider, Beginner, Intermediate, Experienced, Expert and Top performer) along with actions resulting in a report for superior digital stage transition, describing the barriers for progression and advising on how to overcome it (Schumacher, Erol, & Sihm, 2016).

Finally, there is the **360DMA Model** (Colli, Madsen, Berger, Møller, Währens, & Bockholt, 2018) that is based on 5 different steps, which in turn are based on the PBL model. The first step is “Creation of Awareness”, where there is a general overview of what

digitalization is about, while demonstrating its implications through workshops conducted with external specialists or via demonstrations in made-up Industry 4.0 factories. Next comes the “Definition of Scope” stage, which identifies a unit of analysis prior to any assessment. It is then followed by a “Data Collection” stage through a “self-assessment” questionnaire, delivered to the relevant stakeholders related to the already identified unit of analysis, and an eventual expert interview workshop. Similarly, this questionnaire takes into account five dimensions (Governance, Technology, Connectivity, Value Creation and Competences) and each one is evaluated in the stage of “Evaluation And Solution Selection”. In addition, the current maturity stage is assessed through six possible levels (None, Basic, Transparent, Aware, Autonomous, and Integrated). This makes it possible to recognise the areas that lack digital enablers and outlines a direction for the appropriate development activities based on the strategic focus and unit of analysis. Finally, in the last stage, defined as the “Debriefing”, the results are presented through a spider graph that takes into account each dimension and maturity stage (Appendix 4), followed by proposed pilot projects as a way to manage the identified needs, as well as achieve a superior digital maturity stage.

There were several other models that were taken into account. Some of them were similar to those presented and others did not offer sufficient granularity into the respective methodologies and further development processes (Schumacher et al., 2016). Appendix 5 shows a table where the three aforementioned models can be analysed side by side with all their particularities.

2.4. New Digital Technologies and Services

As previously stated, companies are becoming acutely aware of the urgency to be digital while simultaneously remaining competitive. Once companies start to acknowledge this reality and begin to foster a culture of change and risk taking, along with employees that are ready to face the new digital challenges, they start to align their business strategy with the few

technological changes that surround them (Teichert, 2019). These technological changes arise due to the new digital technologies (which are directly related to industry 4.0), some of them being: Internet of Things, Cloud Computing, Social Media, Big Data and Analytics, Artificial Intelligence, 3-D Printing, etc. (Colli et al., 2018). Out of these new digital technologies, new digital services also arose, such as Customer Relationship Management (CRM), E-commerce and Process Optimization (related to the IoT technologies).

Customer Relationship Management is a great example that shows how digital technologies are disrupting many businesses, demonstrating the importance of managing the interaction with customers (or potential ones) in the current environment (Foltean, Trif, & Tuleu, 2019). There are new media technologies that enable the customisation of communication with clients while also predicting, controlling, and sometimes automating sales from those same clients, so it is a strategy which incorporates both customer interactions and transactions (Greenberg, 2010). Some services related to CRM are for instance: management of different social media platforms, website architecture and digital advertising.

According to PwC, traditional methods of selling to customers have also been disrupted by digital retail and **e-commerce** mainly due to consumers being more empowered with mobile apps, social media and general e-commerce changing buying habits. This new way of doing business allows for retailers to develop business models based on differentiation and segmentation, making way for a personalised, novel and rich buying experience for the consumers (PwC, 2018).

Another topic gathering momentum related to digital transformation is the **Internet of Things** (IoT) which now has the perfect conditions to finally be a reality. The widespread availability of broadband internet, decreasing connecting costs, ascending production/creation of devices with wi-fi capabilities and incorporated sensors, decreased technology costs and the global accessibility to smartphones makes IoT possible (Jacob Morgan, 2014). The main idea

behind IoT is the connection of any device to a network, that can be switched on and off, creating an enormous web of connected devices and people, which in a broader scale can be applied for instance to the concept of smart cities, where the whole city would be interconnected, creating a mechanism to reduce waste, improve energy efficiency and much more. Along with this revolution, some problems arose related to security, privacy & data protection, as well as data storage, which should be taken into consideration when developing this type of technologies (Weber, 2010).

3. Methodology and Analysis

The internship at Nexuscorp initiated in mid-February 2020. As previously stated, the first objective was to perceive how the company can achieve a product-market fit in the digital transformation area. As the second and most relevant purpose of this thesis, focus was placed on the creation of an assessment tool prototype to evaluate the digital maturity of a company, in addition to understanding which type of products/services should be deployed, as a way to promote the digital transformation of that company.

For the first purpose previously mentioned a PESTEL, SWOT and TOWS analysis were conducted, as well as a brief industry analysis. Aside from these, a business model canvas and a value proposition were also developed, although they will not make part of this thesis due to confidentiality requirements. For the second purpose, regarding the digital maturity assessment tool, a specific prototype tool was created taking into consideration all the literature review (in addition to other models), and tested in different companies with the objective of validating the prototype.

3.1 PESTEL Analysis

In order to identify the external forces that influence Nexus' activity, all political, economic, social, technological, environmental and legal factors were examined. In terms of

political standings, having a democracy and an overall stable governing structure implemented in Portugal facilitates the company's operations. Aside from this, the support resulting from the European incentives for entrepreneurship initiatives in general, and to innovation specifically, favours the company's activity in the fields of digital transformation (i.e. applications for the incentives, development of solutions, and their implementation).

Up until this point, the Portuguese economy was going through a growth period, in a recovery that was reflected in numerous industries, which can and should have a digital presence. The overall economic climate was prone to the emergence of companies that would amplify the digital connectivity, thus exponentiating the reach and the volume of business. Notwithstanding, with the current situation surrounding COVID-19, there is a high probability of an economic recession. Because of that, companies are trying to accelerate their innovation roadmaps creating opportunities for start-ups like Nexus to share their technologies as a way to accelerate their digital transformation (Laranjeiro, 2020).

Socially, the growing trend for new technologies' adoption, that in fact facilitates almost every moment of the day-to-day life (such as personal and professional communication, e-commerce, etc.), creates the optimal bridge between consumers and companies that seek to reach them. Furthermore, despite the security flaws that compromise user data, as well as the subversion of social platforms for political purposes, people remain faithful to consumer habits, being now inseparable from social networks, google, etc.

In terms of technology, the *cloud* (and all the capabilities that derive from it) allows the optimization of operations by leveraging algorithms that not long ago were only available to large corporations. Big Data, IoT networks and in the near future artificial intelligence, are and will progressively be available to the competition. Thus, a company that ignores this digital revolution takes the risk of quickly becoming redundant.

Regarding the environmental factor, the overall concern to reduce the carbon footprint is increasing and companies that follow this trend will be able to use this to their advantage in order to attract environmentally conscious consumers. Portuguese companies are becoming mature enough to leave behind harmful environmental practices, and the IoT allows to replace devices that consume more electricity, as well as lessen the use of fossil energies through the optimisation of automobile usage.

Finally, from a legal perspective, the implementation of the GDPR had some repercussions related to the digital marketing software (both analytical and advertisement) which diminished its general capabilities, since now users have the option to deny their actions' tracking. The importance of e-commerce will continue to increase as long as the paradigm of free access to the internet remains unchanged in the vast majority of the population, but along with the GDPR restrictions, new possibilities arose, such as the opportunity to take part in the development of the companies' data protection plan. In addition, as soon as the requirements from the Paris agreement drift into the private domain, compliance departments for this purpose will be required to be put in place.

3.2. SWOT Analysis

With the external framework regarding the opportunities and threats disclosed above with the PESTEL analysis, the SWOT analysis of Nexus incorporates all that information and allows the identification of its strengths and weaknesses. Strengths come mostly from Nexus' human capital and competences, along with the already put in place ecosystem that facilitates its activity, while the weaknesses are mainly related to the fact that the start-up is in its early stage. The SWOT analysis can be perceived as follows:

Table 1 – SWOT Analysis of Nexus

Strengths	Weaknesses
1. Young and dynamic team 2. Agility 3. Sustainability 4. Irreverence 5. Leadership 6. Portuguese DNA 7. Already established LPWA IoT ecosystems 8. Change agents (within the account-based marketing) 9. Added value from the UX design 10. Premium positioning	1. Early stage start-up 2. Small portfolio to present 3. Capital constraints
Opportunities	Threats
1. Ease of remote working (more talent available and reduced facilities' costs) 2. European funds/incentives 3. Unsaturated IoT Portuguese market 4. Companies accelerating their innovation roadmaps 5. Companies reinventing businesses (due to Covid-19)	1. Resistance to change 2. 5G 3. Price wars

3.3. TOWS Analysis

Once all the strengths, weaknesses, opportunities and threats are identified, with the TOWS analysis one can perceive which threats can be softened by which strengths and which weaknesses can be empowered by which opportunities. Additionally, the strengths that will be essential to tackle the opportunities available and the threats that will be compromised by the weaknesses can also be acknowledged.

Table 2 – TOWS Analysis of Nexus

TOWS Matrix		Internal Factors	
		Strengths	Weaknesses
External Factors	Opportunities	• S1-O1: The fact that the team is made of young entrepreneurs, completely embedded in the digital revolution, makes it easier to work remotely as a group • S5-O1: Working remotely can be challenging in many ways, but with good leadership skills present those challenges can be softened • S7-O3: There is a clear opportunity for Nexus to tackle the IoT market within the Portuguese territory, which can be favoured with the already existing IoT ecosystems • S10-O4/O5: This is a critical time to let other companies know what Nexus has to offer	• W1-O2: Nexus' relative inexperience is balanced with the fact that it has the possibility to access European funds which were previously unknown to clients • W1-O3: the market is at an early stage and thereby underdeveloped, therefore, Nexus can participate in the customers' education process conveying the benefits that these solutions can deliver. • W2-O1 – The external talent acquired over time will be invited to integrate its portfolio into Nexus' (if that's the case) as a way to generate more work • W3-O2 – European funds come in hand to subsidize in this early stage
	Threats	• S3-T2: the environmental impact of LPWA networks (such as Sigfox) is inferior to 5G, due to the energy consumption verified on each device • S5-T1: Nexus' leadership skills brought to any digital transformation process will allow for overcoming any stakeholders' reluctance • S7-T2: The maturity stage of the LPWA IoT ecosystems is quite superior when compared to 5G which will take some time to be fully developed • S9-T3: Take advantage of the focus on user experience as a process facilitator, and exchange this idea with every contact • S10-T3: There will be clients willing to pay extra for differentiation. Nexus will explain that its products are not for everyone	• W1-T1: The lack of previous projects might not help with the resistance to change at an early stage

3.4. Brief Industry Analysis

Since the company already possesses advanced capabilities delivering CRM related services and once the aforementioned analyses were put in place, all the conditions seemed to be met in order to develop a service delivery related to IoT. Regarding its applicability, it is

estimated that this type of technology will be mostly in place when it comes to smart cities, smart factories, smart energy, smart agriculture and smart retail. Any specific industry that is related to this type of applications can be considered as a possible target for Nexus. After a careful analysis of several industries within the areas mentioned above, it was perceived that the organic waste management (EY, 2019) and agriculture (Avetisyan, 2017) would be two potential industries to tackle first.

3.5. Digital Maturity Assessment Tool Motivation

Once the market needs were perceived and both the external and internal environment of the company were studied, the type of products and services that Nexus could offer started to become clearer. Although that began to take shape, it was uncertain as to what would be the best way to approach companies and understand how digitally developed they were.

There was a clear need to develop a customised tool that would facilitate the first approach to potential clients and, at the same time, measure their digital maturity. In this manner, it would be possible to evaluate their digital transformation progress and also advise for conceivable solutions, creating a possible link to implement Nexus' products and services (create a means for lead generation).

With this in mind, a learning process began with the analysis of several digital maturity assessment tools. The great majority of the models seemed to be based on the same main methodology of using a survey to assess the digital maturity of an organisation, although the final assessment and its delivery method differed from model to model. The three most relevant models (also covered in the literature review) which ended up being the basis for the Nexus' assessment tool were: the Acatech model (Schuh et al., 2017), the IMPULS model (Lichtblau et al., 2015) and the 360DMA model (Colli et al., 2018). Besides these three, many other models were taken into consideration such as: The Maturity Model SIMMI 4.0 (Leyh, Schäffer, Bley, & Forstenhäusler, 2017), Industry 4.0 Maturity model (Schumacher et al., 2016),

Empowerment and Implementation Strategies for Industry 4.0 (Lanza, Nyhius, Ansari, Kuprat, & Liebrecht, 2016), PwC Maturity Model (Reinhard, Jesper, & Stefan, 2016), The Connected Enterprise Maturity Model (Rockwell Automation, 2014), among others.

Every survey contemplates different dimensions depending on the model (such as Technology, Products, Governance, Information Systems, Culture, Smart factory, Operations, etc) and, pending survey completion, each of those dimensions, and the company as a whole, would be evaluated and given a specific maturity stage, which differed from model to model as well. Regarding the number of dimensions used, some models used more, such as the IMPULS with 6 dimensions and the Industry 4.0 Maturity model with 9; while others used less like the Acatech and the SIMMI 4.0 with 4 dimensions.

Upon studying and analysing the different dimensions of each model, it was perceived that although it is of great importance to cover a considerable amount of dimensions (as a way to get a perspective of the company that is as accurate as possible), the reality was that there were a few overlaps of dimensions in some models. Furthermore, the amount of dimensions assessed (and their importance to the evaluation) should be directly linked to how extensive the overall analysis process will be, as well as, the final purpose of the information retrieved from the survey (the less extensive the whole assessment process is, the more dimensions the model should have, and vice-versa). This concept will be further developed below.

As it relates to the digital maturity stage, each model had its own nomenclature and scale, but overall the models seemed to focus on creating 5 to 6 levels of maturity going from a level of no knowledge/awareness about Industry 4.0 to the opposite extreme, a level of higher supremacy in regards to digital transformation. For the Nexus' tool, it was anticipated that a similar classification would be put in place, although it would be preferable to adjust those stages to the type of services that the company has to offer, thus creating, in most cases, a way to help the client increase its digital maturity with Nexus' services.

In terms of the different phases that each model includes (how extensive the overall analysis is), it can vary widely, depending mostly on the final outcome that the authors want to achieve. Some assessment models are only based on a questionnaire that yields a score for the different dimensions and a level for the digital maturity of the company as a whole, with no further recommendations, as is the case of the Industry 4.0 Maturity Model by Schumacher et al. (2016). Other models, like IMPULS, besides delivering the survey along with the evaluation, also deliver a report with pre-defined possible actions for stage transition depending on the results obtained, identifying the barriers for progression and advising on how to overcome them. Finally, a model such as the one from Achatec combines the survey with visits to the company (which allows a personal approach) resulting in the delivery of a much more personalized roadmap and suggested measures since every area that requires action is plotted into a graph, prioritised and implemented in a logical order (Appendix 6).

Going back to the concept mentioned above, it is important to notice that when the model works as a standalone diagnostic tool, it should focus on as many dimensions as possible in order to give an overview of each singular most important aspect of digital transformation, allowing the company to decide what to do with those results afterwards (in the Industry 4.0 Maturity Model, it accounted for 9 dimensions). On the other hand, if the objective of the model is to help a company achieve a higher maturity baseline, having to assess its maturity level as an intermediate stage, it should focus on the most relevant and core dimensions of digital transformation, since further on in the process each dimension will be analysed along with the deconstructed smaller dimensions, and a personalized most fitting action will be considered to attain a higher maturity stage (in the Achatec Model it accounted for 4 dimensions).

4. Results and Discussion

4.1. Nexus Digital Maturity Assessment Tool Prototype



Figure 1 - Nexus Digital Maturity Assessment Tool Prototype

After analysing how the company would best fit its products and services into the market and studying both its internal and external environment, the first Nexus digital maturity assessment tool prototype was developed, taking all that information into consideration as well as the models analysed.

The main purpose of this tool for the company will be to act as a lead generation magnet and create a framework to approach potential future clients. It is not supposed to work as a standalone tool that only infers an organisation's digital maturity. It is part of a holistic approach of product/service implementation. Bearing this in mind, follows the description of the tool, which accounts for all the information mentioned up until this point.

The whole process is comprised of four stages: (1) *Awareness*, (2) *Data Collection*, (3) *Data Analysis & Solutions Selection* and (4) *Delivery & Implementation*.

The **Awareness** stage initiates when companies get to know about Nexus and its digital maturity assessment tool. The model, just as the ones previously reviewed, is based on a survey.

This survey, made of 30 questions (Appendix 12), will either be suggested by Nexus to other companies directly (if there is a perceived business opportunity) or deliberately filled out by companies that land on Nexus' website and wish to take the test.

Next follows the **Data Collection** stage, where the survey is distributed throughout the company and the results gathered for later analysis. Since the survey is part of a lengthier process, and following the logic unveiled from the other tools' dimensions, it accounts for the evaluation of three distinctive pillars:

- **Organisation & Strategy** – all aspects that concern the company in its current state, regarding the organisation and strategy that are currently put in place. In this dimension, the topics to be evaluated are: culture, human resources, digital awareness, digital strategy and plans, innovation management, digital skill sets, digital skill acquisition, use of KPI's and OKR's;
- **Connectivity** – all the required infrastructural components (hardware and interfaces) for data generation and transmission both inside and outside the company. In this dimension the topics to be evaluated are: autonomous processes, IT security, information sharing, sensors, integrated mobile devices, cloud and dashboards;
- **Algorithms** – all processes for business intelligence related to software and data analysis. Here, the topics to be evaluated include: dashboards/data visualisation, data mining and the underlying digital operational infrastructure, such as servers and cloud computing.

After receiving the responses from the company, the **Data Analysis & Solutions Selection** phase is initiated, whereby Nexus goes through the results and analyses the current digital state of the company, depicting their biggest flaws regarding digital footprint and suggesting the most appropriate solutions. In this phase each one of the dimensions, as well as the whole digital maturity of the company, are evaluated on a scale of 0 to 3 (Figure 1). The

solutions are gathered taking all the information from the surveys into consideration, as well as the digital maturity level attained for each dimension, which can be depicted as follows:

- Unaware (0) – lack of digital transformation pre-requisites along with no digital awareness nor digital strategy. No sense of digital maturity urgency and no concern about competitors' advantage regarding this topic. Overall unawareness about industry 4.0. Companies get this level if: O&S = 0 or 1; Connectivity = 0 or 1 and Algorithms = 0 or 1 (every possible and viable combination for each level can be perceived in the Appendix 7);
- Aware (1) – most or all digital transformation pre-requisites are in place and there are plans to invest in digital developments and technologies. There is awareness of the advantages regarding digital transformation, although little action has been taken in that direction up to this point. No digital interface (or poor one) with clients or employees, and digital data is not in place within the company (or use of rudimental/basic processes for data collection). Companies get this level if: O&S = 1, 2 or 3; Connectivity = 0, 1 or 2 and Algorithms = 0, 1 or 2 (every possible and viable combination for each level can be perceived in the Appendix 7);
- Intermediate (2) – digital strategy plan being developed along with the suitable indicators to quantify the execution status, and investment in digital transformation is being deployed in some areas. Some data is already being automatically collected, but there is still much room for improvement and raise efficiency in data collection. Equipment infrastructure is not exploited to its maximum capabilities, few or no integrated decision-making support systems. Employees have in place the suitable skills to increase digital maturity in some areas. Companies get this level if: O&S = 2 or 3; Connectivity = 0, 1, 2 or 3 and Algorithms = 0, 1, 2 or 3 (every possible and viable combination for each level can be perceived in the Appendix 7);

- Expert (3) – digital transformation strategy has been implemented and the company keeps up to date as a way to incorporate new digital related projects, thereby investing considerably in this matter. Data is collected automatically and systems-integrated communications (internally and externally) are made possible due to the presence of appropriate equipment infrastructure. Use of sensors and the appropriate dashboards are in place, along with IT security and cloud-based solutions. The company is ready to overcome any digital barrier and is ahead of its competitors. Companies get this level if: O&S = 3; Connectivity = 3 and Algorithms = 3.

Finally, comes the **Delivery & Implementation** stage where Nexus delivers a report to the company's senior management with the evaluation, along with the matching possible solutions (a spider graph like the one in the Appendix 8 is plotted and will be included in the report). This deliverable should be submitted preferably on site at the company in question, and the analysis presented, since the solutions will not be described in full detail in the report, only references will be made. The purpose of doing so is to solidify the relationship with the company, while at the same time creating an opportunity for Nexus to deploy their services by helping the company in question increase its digital maturity, thus being better prepared to meet and overcome future challenges. Preferably, follow up meetings should be scheduled at this stage, in order to identify which solution(s) would be the most suitable for the company as well as develop an implementation plan. A possible methodology to use in this phase would be the Design Sprint by Jake Knapp et al. (2017), which was tested within Nexus to validate its value. If the solution cannot be delivered by Nexus, alternatives will be suggested.

4.2. Prototype Validation

Once the model was put in place, several companies were contacted with the objective to validate the model prototype and follow with the necessary improvements. Due to time constraints, the model was only tested with six companies, ensuring inclusion of organisations

within different industries. The companies in questions were: *Recreativos Cristo Rei Lda* in the entertainment industry, *Porto Loops* in the tourism industry, *Essilor Portugal* in the medical equipment industry, *G. Leal & CA, SA* in the metallurgical industry, *Ourogal* in the olive oil industry and finally *Bosque da Raposa* in the agricultural industry. Notwithstanding, there is the realisation that more companies will need to be addressed to arrive to more solid conclusions.

From these six companies, three were selected (which were evaluated and met the first three respective maturity levels of the model) to demonstrate their different digital maturity and possible respective solutions presented by Nexuscorp, as a way to improve it.

The first company to be presented is *Recreativos Cristo Rei Lda*, working in the entertainment industry, with a headcount of 10 to 49 employees and focusing on the recreational gaming machine business. After receiving six complete answers to the survey followed by its analysis, the digital maturity assessment was depicted as shown in Appendix 9. The digital level attributed in this case was *Unaware*, since the company demonstrated no knowledge about the industry 4.0 and thereby has no digital strategy for the future. There is few to little information shared via digital means to some extent, but no aspect contemplated within the Algorithms dimension is in place. With this in mind, the solution that Nexuscorp would deliver as a service would consist of **educational workshops** with the intent to educate employees about industry 4.0 and alerting senior management to the importance and the potential that this type of concern can bring to the whole operation of the company.

Another company that answered the survey was *Porto Loops* within the tourism industry, which delivers different motorcycle routes for tourists who want to explore Porto in a unique manner. The company has a small workforce (less than 10 employees), thereby with the two responses to our survey the digital maturity assessment was conducted as perceived in Appendix 10. The company demonstrated some awareness about industry 4.0 and the potential

derived from being prepared to tackle it. There is a digital strategy in place (although not substantial) and plans to invest in digital transformation in the future. Data collection can be optimized, no presence of any technology related to the Algorithms dimension and digital presence can be significantly increased. The digital maturity level in this case would be *Aware* and a possible solution for this specific company would be the deployment of **digital marketing services**, which would include social media management services, Search Engine Optimization services, both local and international (since this is a touristic activity), chatbots services, etc.

Finally, *Essilor Portugal* which is an organisation that designs, produces and markets lenses that correct, as well as protect the eyesight, also answered the survey. The company operates in the medical equipment industry with a headcount between 100 and 500 employees. With a total of 8 responses, its digital maturity assessment was portrayed in Appendix 11. Employees seemed to be prepared to grow the company's digital maturity and overall were aware of industry 4.0. The company already makes use of cloud computing and has cybersecurity services in place. Some data is already being collected automatically, although its analysis quality treatment seemed to be inefficient. The level attributed for this company was *Intermediate* and the respective possible solution would be based on a delivery of an **IoT service** for manufacturing, distribution, stock management and/or other areas where this service could bring higher efficiency to the whole operation, opening a way to create integrated systems to help decision making.

The solutions chosen for each company, and in this case for each maturity level of the model, are not “one size fits all” solutions. As stated previously, when referring to each organisation's solutions, these are only “possible solutions” which can be changed or tweaked once the *Delivery & Implementation* phase starts. In this phase, there will be an opportunity to gather further insight of the company in question and customise a solution that will best fit its needs

5. Limitations and Further Analysis

Overall, the assessment part of the whole model prototype worked in a satisfactory way, delivering a global adequate perception of the companies' digital maturity. However, there is the understanding that the prototype is still in its initial development and there will be improvements required. It was perceived that in some companies the survey was answered only by employees of a specific department or hierarchy. Therefore, for future companies, it will be asked for a minimum of two employees of a specific department and hierarchy to answer the survey as a means to obtaining an omnidirectional perspective of the digital maturity of the company (this will depend on the size of the firm in question).

Although the first stages of the model were tested (*Data Collection* as well as *Data Analysis & Solutions Selection*), the following stages could not be tested due to time constraints, in addition to the COVID-19 pandemic situation. Even with six companies answering the survey and after analysing each situation, it can be perceived that this amount of companies is not enough to obtain significant and final conclusions. Thereafter, further analysis will not only comprise more companies to answer the survey, but will also give continuity to the process as a whole. Meaning that, after preparation of the full report (including the conclusions derived from the total amount of answers of a given company, along with the appropriate possible solutions) one face to face meeting at the company in question should be requested in order to present the report. This will enable a detailed explanation of the solutions (which will not be included in the report itself). This meeting will be a critical milestone to: (1) explain the advantages that the solution will bring to increase digital maturity, (2) opportunity to get to know the company better, in order to develop a solution that is as appropriate as possible to its current situation and, (3) schedule follow up meetings and proceed with the implementation component of the last phase of the model.

Finally, in terms of the roadmap for Nexus' digital transformation business development, it consists of the following stages: (1) launching pilot projects that can yield not only proof of concept but also client feedback in a controlled environment, (2) receive funding for hardware and software acquisitions, and (3) hiring an inside sales team to drive the business forward.

6. References

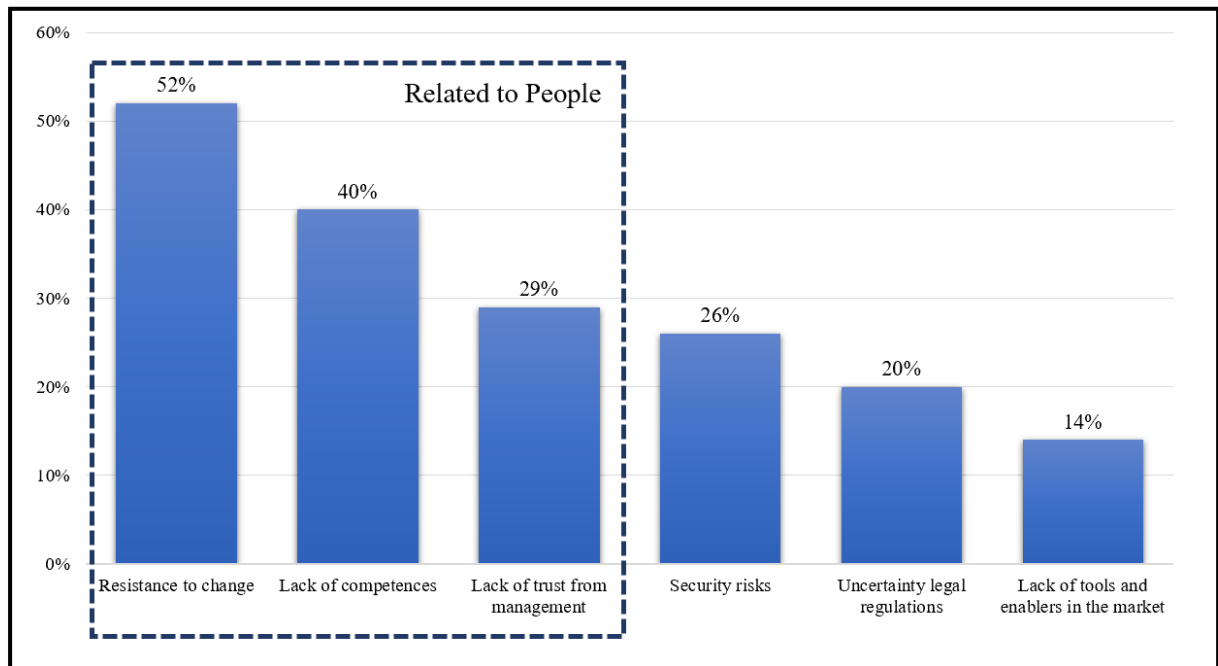
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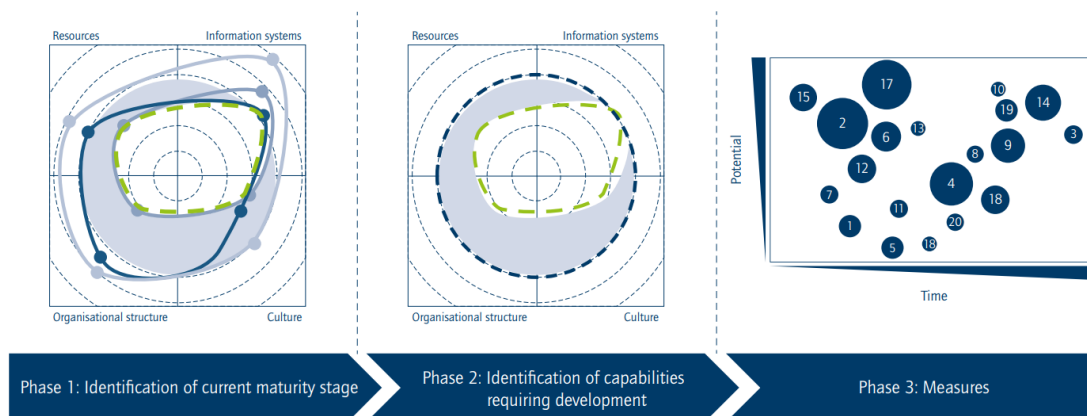
7. Appendices

Appendix 1 – Main Challenges for Digital Transformation



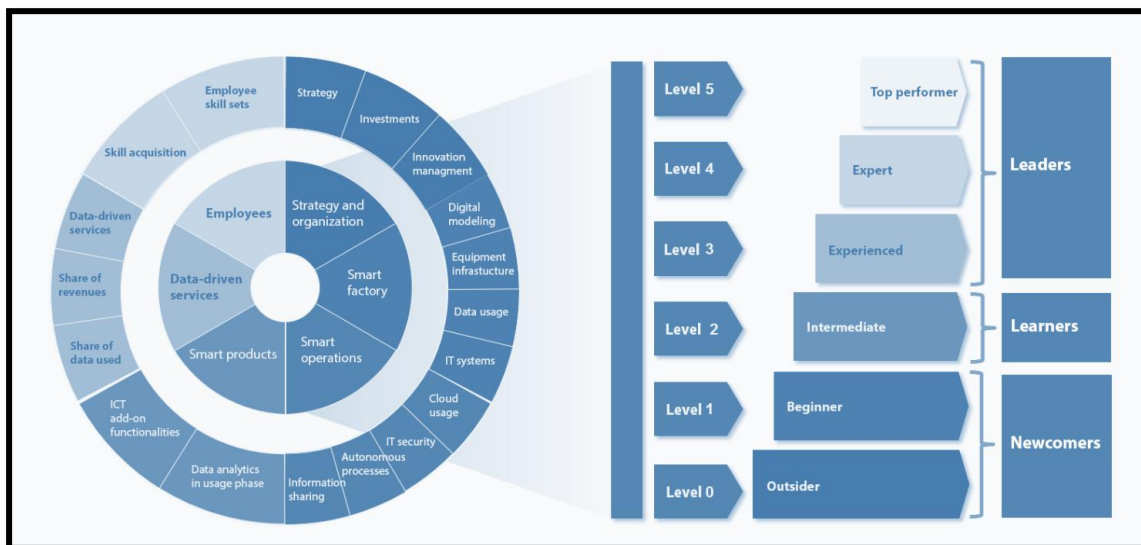
Source: INSEE, Roland Berger Study (505 companies interviewed)

Appendix 2 – Application of the Acatech Maturity Index



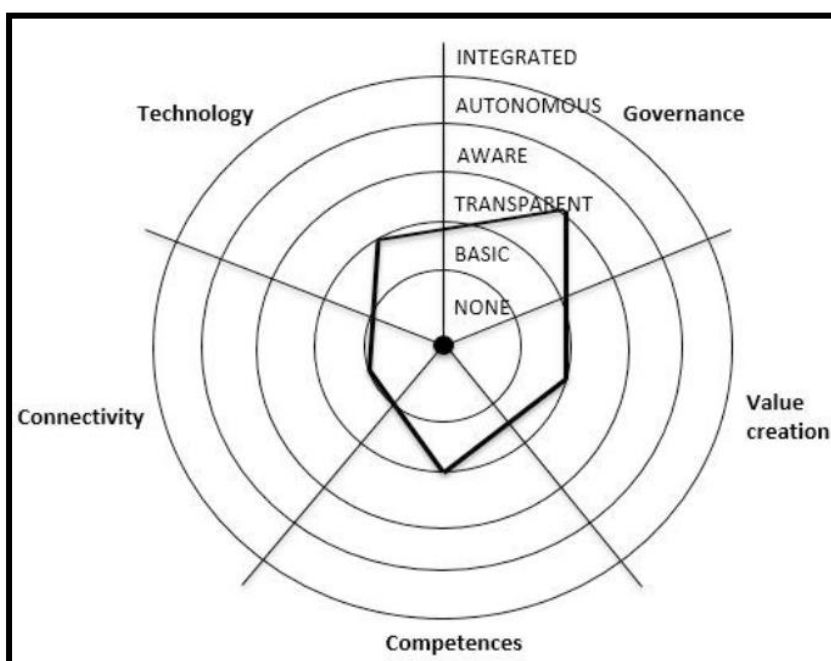
Source: Industrie 4.0 Maturity Index – Acatech Study, pg. 44

Appendix 3 – IMPULS Model main features



Source: IMPULS Industry 4.0 Readiness Model

Appendix 4 – Demonstration case example of the 360DMA Model

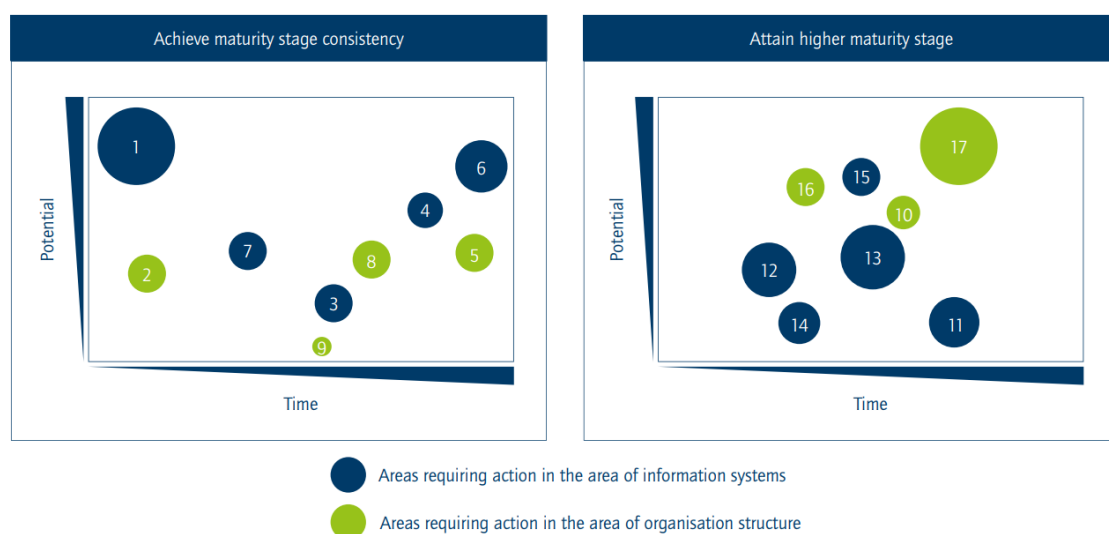


Source: Contextualizing the outcome of a maturity assessment for Industry 4.0. M. Colli, O. Madsen, U. Berger, C. Møller, B. Vejrum Wæhrens, M. Bockho. IFAC-PapersOnLine. 2018. Pg. 4

Appendix 5 – Table 1. – Models to assess Industry 4.0

Model Name	Process Phases	Dimensions	Maturity Levels	Overview
Acatech – Industrie 4.0 Maturity Index	1. Identification of Current Maturity 2. Identification of capabilities requiring development 3. Measures	• Resources • Information systems • Organisational structure • Culture	1. Computerization 2. Connectivity 3. Visibility 4. Transparency 5. Predictive capability 6. Adaptability	• Self-assessment survey is combined with visits to the company • Examination of the different capabilities of each area of the organisation
IMPULS – Industrie 4.0 Readiness	No defined phases	• Strategy And Organisation • Smart Factory • Smart Operations • Smart Products • Data-Driven Services • Employees	0. Outsider 1. Beginner 2. Intermediate 3. Experienced 4. Expert 5. Top performer	• Self-assessment through an online questionnaire • Delivery of possible actions for maturity level transition
360DMA Model	1. Creation of Awareness 2. Definition of Scope 3. Data Collection 4. Evaluation And Solution Selection 5. Debriefing	• Governance • Technology • Connectivity • Value Creation • Competences	1. None 2. Basic 3. Transparent 4. Aware 5. Autonomous 6. Integrated	• Questionnaire to assess digital maturity level • Methodology based on the PBL model

Appendix 6 – Identification of measures in the Acatech Maturity Index



Source: Source: Industrie 4.0 Maturity Index – Acatech Study, pg. 47

Appendix 7 – Possible and viable combinations of each dimension’s level

	Digital Maturity Levels			
	Unaware	Aware	Intermediate	Expert
Possible and viable combinations of each dimension’s level	(0,0,0) (1,0,0) (0,1,0) (0,0,1) (0,1,1)	(1,0,1) (1,1,0) (1,1,1) (1,0,2) (1,2,0) (1,2,1) (1,1,2) (2,0,0) (2,0,1) (2,1,0) (2,1,1) (3,0,0) (3,1,1) (3,0,1) (3,1,0) (0,2,0)	(2,0,2) (2,2,0) (2,1,2) (2,2,1) (2,2,2) (2,0,3) (2,3,0) (2,1,3) (2,3,1) (2,3,2) (2,2,3) (2,3,3) (3,0,2) (3,2,0) (3,0,3) (3,3,0) (3,1,2) (3,2,1) (3,2,2) (3,1,3) (3,3,1) (3,2,3) (3,3,2)	(3,3,3)
(O&S, C, A)				
O&S – Organisation and Strategy				
C – Connectivity				
A - Algorithms				

Notes: (1) The first number contemplated within the parenthesis refers to the Organisation and Strategy dimension, followed by Connectivity and the third number corresponds to the Algorithms dimension;

(2) Any other combination that is not contemplated in this table constitutes a very particular situation placed in the frontier between two levels, which will fall into one or another depending on the subsequent analysis.

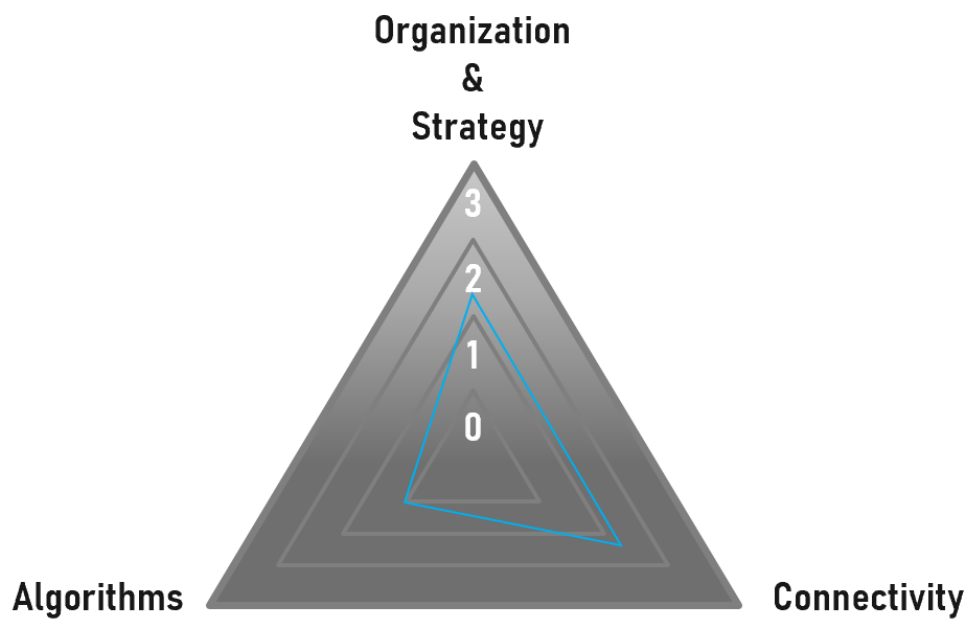
Appendix 8 - Demonstration case example of Nexusc corp’s Model



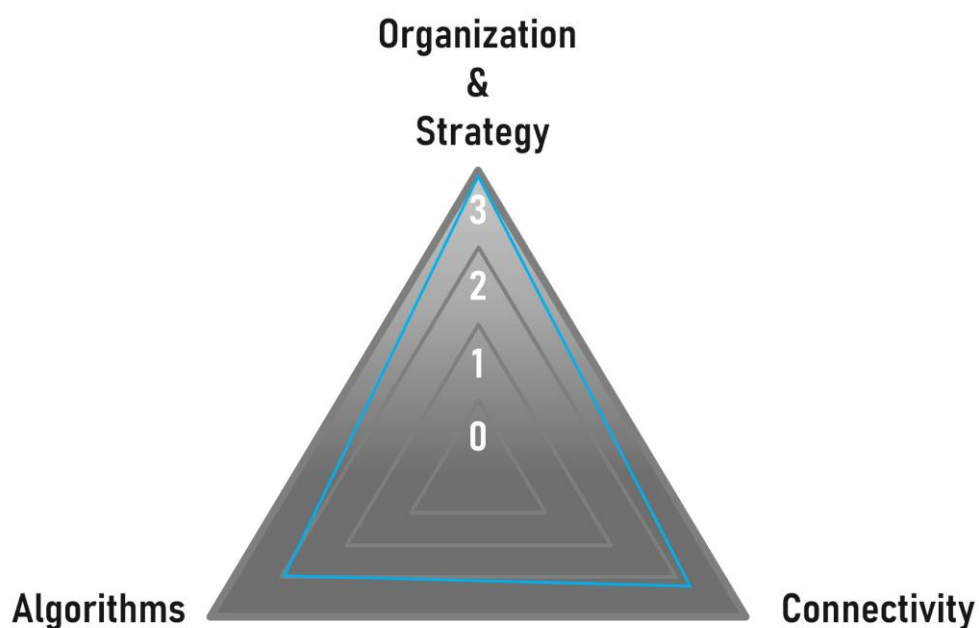
Appendix 9 - *Recreativos Cristo Rei Lda*'s Digital Maturity Assessment (digital stage concerning the three digital dimensions)



Appendix 10 - *Porto Loops*' Digital Maturity Assessment (digital stage concerning the three digital dimensions)



Appendix 11 - Essilor Portugal's Digital Maturity Assessment (digital stage concerning the three digital dimensions)



Appendix 12 – Nexuscorp's Digital Maturity Assessment Survey



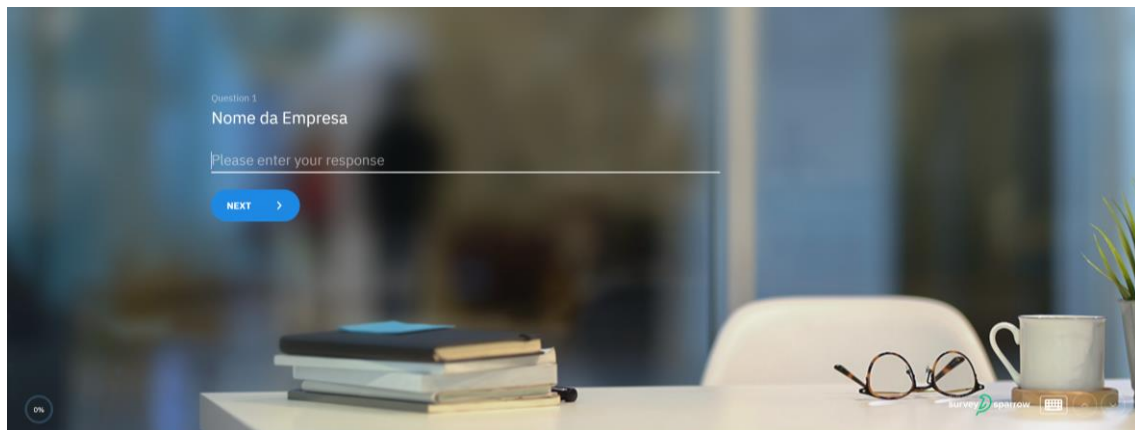
Question 1

Nome da Empresa

Please enter your response

NEXT >

0%



Question 2

Cargo

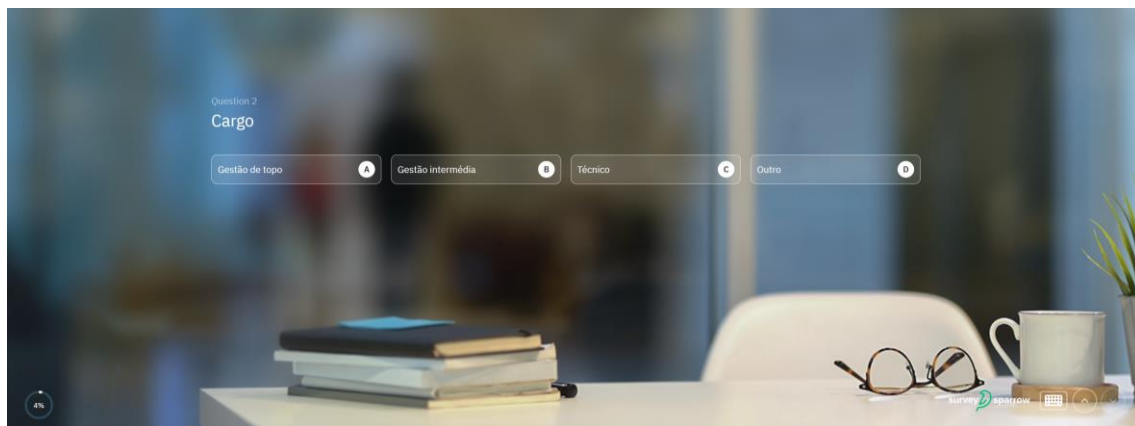
Gestão de topo ☐ A

Gestão intermédia ☐ B

Técnico ☐ C

Outro ☐ D

4%



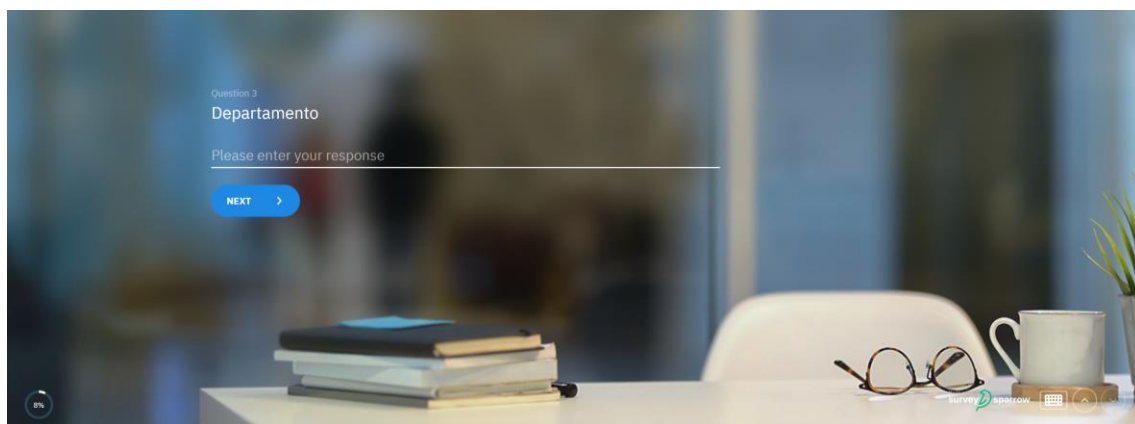
Question 3

Departamento

Please enter your response

NEXT >

8%



Question 4

Número de trabalhadores

0 - 9 ☐ A

10 - 49 ☐ B

50 - 99 ☐ C

100 - 500 ☐ D

+500 ☐ E

Não sei ☐ F

12%



Question 5

Sector de Actividade

Select

10%

Question 6

Que tipo de tecnologias 4.0 já são utilizadas na sua empresa?

IoT A

Big Data B

Cibersegurança C

Inteligência Artificial D

Cloud E

Blockchain F

Nenhuma das apresentadas G

NEXT >

19%

Question 7

Com quais delas está familiarizado em termos conceptuais?

IoT A

Big Data B

Cibersegurança C

Inteligência Artificial D

Cloud E

Blockchain F

Nenhuma das apresentadas G

NEXT >

24%

Question 8

Em quais destes departamentos houve um investimento no sentido da transformação digital das operações, nos últimos 2 anos?

Investigação e Desenvolvimento A

Produção B

Compras C

Vendas D

TI E

Nenhuma das apresentadas F

NEXT >

24%

Question 9

Quão informatizados estão os processos internos na sua empresa?
Classifique de 1 a 10 sendo que 1 - completamente manual e 10 - completamente automatizados

1	2	3	4	5	6	7	8	9	10
---	---	---	---	---	---	---	---	---	----

100% MANUAL 100% AUTOMATIZADO



Question 10

Em quais destas áreas está planeado um investimento no sentido da transformação digital das operações, nos próximos 5 anos?
(Caso não tenha conhecimento, escolha a última opção)

- Investigação e Desenvolvimento ☐
- Produção ☐
- Compras ☐
- Vendas ☐
- TI ☐
- Nenhuma das apresentadas ☐
- Não tenho conhecimento ☐

NEXT



Question 11

As métricas mais importantes para a sua empresa necessitam de acompanhamento constante.

Através de que meios e com que frequência é que este controlo é feito?

- Revisões de Performance (manuais) - Anual ☐
- Revisões de Performance (manuais) - Trimestral/Mensal ☐
- Painéis de Instrumentos (dashboards) - actualização manual ☐
- Painéis de Instrumentos (dashboards) - Tempo real ☐
- Nenhuma das apresentadas ☐
- Não aplicável ☐

NEXT



Question 12

Qual é o seu grau de confiança na subcontratação de serviços fulcrais à sua actividade?
Sendo 1 - nada confiante e 10 - plenamente confiante

1	2	3	4	5	6	7	8	9	10
---	---	---	---	---	---	---	---	---	----

NADA CONFIANTE TOTAL CONFIANÇA



Question 13

Já decorreram ou estão planeadas formações para equipar a força laboral com os conhecimentos essenciais neste novo paradigma 4.0?

Passa à próxima pergunta caso não saiba



Sim Y



Não N

SKIP

43%

Question 14

Quais as suas principais ferramentas de trabalho?

Refira o software e/ou o hardware que utiliza diariamente

Please enter your response

HS SHIFT + ENTER for new line

NEXT >

44%

Question 15

Quais são as suas principais preocupações no dia-a-dia da empresa?

Fale-nos um pouco das suas funções e das ferramentas que utiliza diariamente

Please enter your response

HS SHIFT + ENTER for new line

NEXT >

52%

Question 16

Qualquer processo de transformação digital exige colaboradores com competências 4.0.

Sente que a sua empresa está preparada para enfrentar estes novos desafios com os seus recursos humanos actuais?



Sim Y



Não N

54%

Question 17

A sua empresa possui algum sistema de telemetria de dados?
Seja no processo produtivo ou integrado no produto final

☒ Sim ☐ Não

60%

Question 18

De 1 a 10, classifique a qualidade do tratamento dos dados que são recolhidos
Pode passar esta pergunta à frente caso não esteja a par deste parâmetro

☒ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10

MUITO BAIXA MUITO ALTA

SKIP

65%

Question 19

Quão informatizada está a interface da sua empresa com os seus clientes e colaboradores externos?
Classifique de 1 a 10 sendo que 1 - completamente manual e 10 - completamente automatizados

☒ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10

100% MANUAL 100% AUTOMATIZADA

68%

Question 20

Se amanhã surgisse uma oportunidade para um aumento do volume de negócio na sua empresa - que exigisse um aumento de 500% da capacidade produtiva do seu departamento - em quanto tempo acha que lhe conseguiriam dar resposta?
Inclua o tempo necessário à contratação de pessoal, se aplicável

☒ 1 mês ☐ 3 meses ☐ 6 meses ☐ 1 ano

☐ Não Sei ☐ Outro

69%

Question 21

Por favor justifique a resposta à pergunta anterior.
Considere não só os obstáculos mas também as valências a favor

Please enter your response

HOLD SHIFT + ENTER for new line

NEXT >



Question 22

Como é feita a recolha de dados ao longo da cadeia de valor da sua empresa?

Classifique de 1 a 10 sendo que 1 significa que predomina a intervenção humana e 10 que tudo é feito de forma automática (com recurso a sistemas de telemetria)?

1	2	3	4	5	6	7	8	9	10
---	---	---	---	---	---	---	---	---	----

100% MANUAL 100% AUTOMATIZADA



Question 23

Os colaboradores da sua empresa possuem as competências para criar e/ou capturar fluxos de dados que informem os processos de tomada de decisão.

Concordo plenamente A Concordo B Não sei C Discordo D

Discordo em absoluto E



Question 24

Relativamente ao aspecto anterior, diria que o seu departamento está à frente das outras valências da empresa?

Sim Y Não N



Question 25

De 1 a 10, quão preparada está a sua empresa para combater o investimento que a vossa concorrência faz nos canais digitais?

1	2	3	4	5	6	7	8	9	10
---	---	---	---	---	---	---	---	---	----

NADA PREPARADA PRONTA

50%

survey asparrow

Question 26

Está satisfeito/a com os esforços desenvolvidos pela sua empresa no sentido da transformação digital de processos?

✓
Sim Y

✗
Não N

50%

survey asparrow

Question 27

Qual a moldura temporal em que pretende ver concluídos os projectos de transformação digital, tanto os que estão em curso como os que estão no pipeline?

3 meses A

6 meses B

1 ano C

2 anos D

Não há prazo definido E

Não aplicável F

50%

survey asparrow

Question 28

Por favor insira o seu nome e email

Para podermos contactá-lo(a) posteriormente e entregar o relatório da avaliação

Name

Email

NEXT >

50%

survey asparrow

