A Strategic Model and Framework for Intelligent Process Automation

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Abstract — **Digital transformation has been growing inside companies and impacting the economy and society. Operations are one of the nine business dimensions where this transformation can be accelerated. This study answers the research goal of building a strategic model and framework for intelligent process automation implementation, to accelerate companies' digital transition. The significant value and contribution of the proposed artifacts were proved by its demonstration and assessment.**

Keywords - strategic model; digital transformation; artificial intelligent; intelligent automation; intelligent process automation; design science research.

I. INTRODUCTION

The International Data Corporation (IDC) considers Digital Transformation (DT) as a requirement to organizations' subsistence, which can be significantly accelerated through the operations dimension [1].

This study aims to answer the question of "How can companies accelerate their DT through Intelligent Process Automation (IPA)?". It starts by studying the fundamental findings in DT and IPA, that support the design of a Strategic Model and Framework proposed to help organizations in IPA implementation to accelerate their DT. A use case and an expert's analysis were conducted to assess the proposed solution, enabling a final discussion and conclusions.

A Design Science Research (DSR) methodology is used in this study to specify the problem, seek the knowledge based on scientific research and theory to understand it, and then answer it by creating and evaluating the strategic model and framework, proposed [2]. The taxonomy in [3] and the analysis framework in [2] also help to confirm this approach.

For the production and presentation of this DSR, it was considered the seven guidelines in [4] and the DSR process in [5] consisting of six steps: Identify the problem, define the objectives, build the solution, demonstrate it, evaluate it and communicate it.

Overall, this study will contribute to the digital economy evolution by giving to organizations a strategy and process to follow in IPA implementation, and to the scientific community that can use a new strategic model and framework to study this subject continually.

This paper summarizes the study conducted by firstly presenting the concepts and main aspects of DT and IPA, secondly describing the strategic model and framework proposed, then it highlights the results of the artifacts assessment, and finally provides the study's conclusions.

II. DIGITAL TRANSFORMATION

From the current literature review, it is possible to conceptualize DT as a process undertaken by companies that strategically use new technologies to transform their business model progressively to innovate and create a better value proposition for all stakeholders [6-9]. This study addresses five main aspects that companies must know to achieve DT: Drivers, impacts, challenges, assessment and strategies.

The advancement of technology and the digital disruption caused by the covid-19 pandemic are the main drivers to DT [1, 6, 10]. Economic factors are the importance of innovation, changes in customers' behaviors, mobile, globalization and industry 4.0. technological contributions are the appearance of the internet of things, big data, blockchain, Cloud Computing (CC), nanotechnology, virtual reality, robots and Artificial Intelligence (AI) [1, 6, 9-20].

Some positive impacts of DT on organizations are processes improvement, automation, and elastic resources, enabling operational efficiency and cost savings. Moreover, big data provisioning supports better decision-making and real-time response to market changes [6, 7, 9, 11-15, 17, 18, 21, 24]. However, organizations are now facing concerns regarding security, privacy, and safety of digital assets [9], and how to deal with ethical and moral issues [30].

The first challenge for organizations is to understand the meaning of DT and what it entails, then, it follows the inertia and resistance of employees, the lack of vision and regulation, unclear roles and responsibilities, no organizational units' alignment, not enough funding, or Information Technology (IT) systems limitations [8, 10, 16]. In general, organizations have difficulties converting technological innovation into financial profits [7, 13].

The four levels of digital mastery [19] and the DT self-assessment questionnaire [18] seem to be the most known ways of DT assessment. Although there are other researchers [8, 23, 25, 26] studying and proposing models to assess companies' digital maturity, there is no consensus between models [27].

To succeed, organizations must align their business and IT strategy [50]. DT strategy must be aligned with other corporate strategies [22] and consider new technologies that enable business process reengineering and optimization, organizational structure and culture, leadership, employees' roles and abilities [6, 7, 9, 16, 17, 26], the barriers to change as inertia or resistance [9, 26], cybersecurity and data privacy [13].

The most known strategies and approaches to implement DT seem to be the digital transformation compass [19], the four

dimensions of DT strategy [22], the five domains of DT [18] and the five building blocks to DT [8]. Although, there are other researchers that propose different methods [6, 8,10, 15, 17-19, 28]. In general, the main areas that most organizations are digitally transforming are customer experience, processes, and business models [6, 8, 21].

III. Intelligent Process Automation

Intelligent Automation (IA) can be used in all organization functional areas, but this study is focused on IPA, more specifically, on how to implement the automation of human decisions and actions. In this context, it was essential to study the technologies and concepts that lead to IPA.

Business Process Automation (BPA) is part of the Business Process Management (BPM) discipline [35] and it aims to reengineer and improve processes to reduce inefficiencies, collecting data to discover, enhance and monitor processes [33]. Workflow platforms are used in BPA to improve processes through automation. They are capable of data integration from other applications [35] and, using Application Programming Interfaces (APIs), and CC companies can access real-time data [33, 35]. These platforms use process and task mining techniques to understand business processes maturity and enable the Robotic Process Automation (RPA) opportunities identification and the observation of process enhancement results [32].

RPA is a software-based solution focused on creating digital workers to do repetitive tasks with structured data input [37] and it can be used to collect and integrate data into workflow platforms [32] when APIs require high programming skills or the developers do not know very well the applications [31, 34, 36]. A chatbot is an RPA application developed to help organizations in customer service. It can imitate written and verbal human speech to answer customer questions or needs [10]. Combining with AI it can be used to analyze customer preferences based on the content text of its conversations with the chatbot [38].

AI is the development of software that automates knowledge work to imitate human behaviors and capabilities, but alone it is not capable of cognitive tasks execution [30]. It needs RPA and big data to achieve its goal [41].

Big data analysis makes possible the transformation of data into information, allowing better decisions and actions made by business managers and analysts [40] or, using AI, by software-based automation [14]. Business Intelligence (BI) combines several technologies, methods and tools that enable interactive access to data and its manipulation, sometimes in real-time [40].

IPA uses RPA, AI models and big data to provide prescriptive analytics and cognitive decision-making based on structured or unstructured data, such as images, text, videos and voice. These technologies together can imitate human decisions and act upon them [37, 38, 41], and bring several benefits to companies' operations [38].

One of the most important advantage is that integrating RPA with technologies like machine learning, Natural Language Process (NLP) and data analytics enables digital software assistance to control, manage and improve business processes in real-time and optimize their efficiency [32, 38, 39]. Another worthy benefit is that combining several technologies, methods and techniques enables the creation of new business models that lead to DT acceleration [20, 32, 33, 38, 39].

On the other hand, some of the companies' challenges regarding IPA implementation are the expert trust dependency, cultural readiness and staff reskilling, integration with legacy systems [38], the support to benefit collecting and monitoring, methodological support to implementation and the lack of techniques for task selection and scalability management [42].

Before starting IPA implementation, companies have critical considerations to do. They must develop a roadmap and strategy, ensure technology readiness, guarantee human resource capabilities, implement change management, maximize the impact through full use of IPA solutions portfolio and have the mindset of building rapid minimum viable products [38].

In the academic context, it was possible to find only two general approaches that guide companies in IPA implementation. The study "Hyperautomation for the enhancement of automation in industries" [20] and the book "Intelligent Automation (IA)" [30].

The first study proposes six technologies that must be aligned and presents a process to achieve hyperautomation. However, the general use of this approach is not very clear, it gives guidance to companies, but it lacks its demonstration and evaluation. The book proposes a roadmap for IA transformation and highlights the need of the senior management support to succeed, which means that organizations that do not have senior management support will find it challenging to follow roadmap.

In the industry context, many consulting companies study and develop models, frameworks, roadmaps, and toolkits for IPA implementation. However, these approaches are only available as a service to buy and the free information related to them is not enough to help companies. Among all consulting companies considered in this study, the most known are Gartner, Ericson, IBM, Accenture, Deloitte, GCI and Capgemini [43-49].

IV. IPA Strategic Model and Framework

A. IPA Strategic Model

A strategic model for IPA implementation was designed to conceptualize the strategy behind IPA implementation. The following description is a reviewed version of the first strategic model proposed, incorporating the recommendations given by experts interviewed to enable its evaluation and discussion.

This strategic model is composed of four strategic groups:

1) The Environment: IPA is only possible in an environment where the following three elements are present and interact:

a) Digital Transformation: Organizations must have a DT strategy aligned with their Business and IT strategies because IPA adoption success depends on how the change is managed, employees' needs and worries are considered, what is the customers satisfaction during process changes and how concerns about cybersecurity and ethical issues are handled;

b) Business Users & IPA Developers: IPA is usualy developed by and for business users but there are also cases

where companies opt for centralized models where IPA developers only do this work and are not business users. In these cases, business users consume IPA as they consume IT;

c) IT&HR Support: IT support is needed to integrate organizations IT infrastructures. HR must contribute to DT, managing and upgrading employees' skills, and promoting a digital, open and forward-looking mindset and culture. IT and HR business areas can work together to create IT communities to support employees dealing with DT and IPA implementation.

2) The Pillars: Three pillars allow all other elements to function and support the organizational change management:

a) BPM: Organization processes must be documented and managed considering continuous control and enhancement. BPM and BPA methods and techniques help organizations to be operational while improvements are being implemented to ensure high-quality levels and digital maturity;

b) Knowledge Management (KM): Comercial offers, campains, procedures and all the knowledge that employees need to execute tasks must be easily available and updated in KM platforms, each time an IPA is implemented, to ensure the quality of products and services and customer service making digital and human work collaboration possible;

c) BI: To introduce AI in an organization, BI methods, techniques and specialists are required. Companies can have external consulting at the beginning of IPA adoption, but it is essential to have internal employees with the skills needed to ensure the continuity and scalability of IPA implementations. data analysts can use BI systems to support decisions based on descriptive, prescriptive and predictive analysis.

3) The Visualization: This group supports the IPA need, business case design, and benefits tracking, demonstrating IPA value to organization. Four elements work together or alone to show actual processes, where it is possible to visualize IPA opportunities, and their benefits after implementation:

a) Applications: Organizations' value chain is supported by different applications that collect data needed to discover, enhance and monitor processes. There are also other applications whose primary goal is to monitor business or other key indicators, give the information needed to make decisions and allow IPA opportunities identification and visualization of IPA implementation results;

b) Workflow Platforms: Use process and task mining techniques to discover, enhance and monitor processes by integrating value chain applications and collecting their data to digitalize processes. These systems enable a better BPM and allow the identification of IPA opportunities and the visualizatiom of results and benefits from its implementation;

c) APIs and AI: To achieve real-time data integration between value chain applications and workflow platforms, companies can use APIs and AI technologies as CC. Some applications already have this integration capability and do not need APIs and AI.

d) RPA: When APIs are not available and the integration of the legacy system is needed, RPA can be used as an alternative to data integration.

4) 4. The Creation: Depending on the IPA need, diferent types of IPA can be created. This group of four elements, make possible the creation of the IPA needed:

a) RPA: An IPA is just capable of cognitive tasks execution using RPA software. Depending on the problem to solve or need to satisfy, organizations will configure the AI models that answer those questions and use RPA to IPA conceptualization to perform the required intelligent tasks;

b) Chatbots: Chatbots are RPA software used for interactions with humans. If the IPA goal is to support employees' activities or enable good customer service while collecting preferences and purchase patterns, companies will develop a chatbot that uses AI to analyze text or voice through NLP or voice recognition to understand people's needs and give answers based on that analysis;

c) Big Data: Data availability is fundamental for AI models' quality and performance. How much data is accessible, better results will be achieved. At the beginning of IPA adoption, organizations will need data engineers to analyze their data to understand if it is suitable for AI models configuration or needs some arrangements first. BI methods and techniques are helpful in this analysis;

d) AI Models: Depending on the organizations' needs, Data Scientists will build, configure and test the right AI models capable of learning and mimic human congnitive decisions to be integrated with RPA or chatbots to solve problems and enhance processes. These models need data availability to be accurate and improved over time. At the beginning of IPA adoption, organizations will need time to build these models, but they must be scalable to answer future business cases decreasing the implementation effort over time.

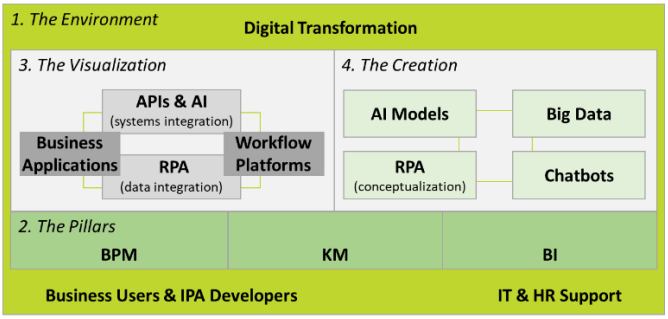

Figure 1. IPA Strategic Model

B. IPA Framework

An IPA framework is proposed to complement the strategic model with a step-by-step process to IPA implementation capable of transforming the concept into action.

1) Before starting IPA adoption, companies need to evaluate if they are ready to do it. Therefore, there are three initial requirements to the successful use of this framework:

a) Organizational Model: this framework is only valuable for companies already going through their DT having a strategy aligned with business and IT, and that need guidance to give the next step towards IPA implementation will;

b) Existing Tools: BPM, KM, BI, and workflow platforms are essential for a successfull IPA implementation because they enable company's change management, IPA opportunities identification and the visualization and monitoring of results from IPA implementations;

c) Human Skills: companies need professionals already familiar with BPM, KM, BI, workflow platforms, RPA and the business itself, having some automation already in production. To go further, companies need availability to increase their human skills to introduce and integrate AI features with automation to create value answering stakeholders' needs.

2) Considering the strategic model and the initial requirements, a company can start IPA adoption in six steps:

1st) IPA needs Identification: Workflow and BI platforms allow process owners and business analysts to identify IPA opportunities. In this first step of IPA implementation, it is crucial to build a detailed business case with a value analysis that predicts the benefits for the IPA oportunity and to identify the related data that can be used in IA models configuration. These needs can emerge from a process enhancement or to answer a specific business problem or question;

2nd) Prioritization and Planning: Once several needs are identified, organizations must prioritize them considering data availability, likelihood of failure, level of scalability and predicted benefits. The analysis of IPA's implementation value is fundamental in this step because technological decisions are increasingly based on value for the business. Having an IPA business case portfolio helps organizations better understand their IPA needs and predict the scalability of future developments, enabling better comparison, prioritization, and planning;

3rd) Data analysis and AI models configuration: BI specialists need to perform data analysis after choosing the better business case to start IPA implementation. Different AI models can be compared to identify the most suitable, considering the business case and AI features needed. Then this model is configurated to perform the expected cognitive decision-making activities. Data scientists will need business managers' knowledge to support IA models configuration aligned with business context;

4th) Testing and Machine Learning: AI models must be tested, trained and retrained using data and human decisions as sources of knowledge for machine learning. These tests and machine learning are repeated until the data scientist responsible considers that the model has a reasonable confidence interval. IA models must be maintained and should be reviewed over time;

5th) IPA Development: Depending on the IPA complexity, RPA, chatbots or other software-based automation can be developed during the third and fourth steps or after them. Nevertheless, in the fifth step happens the integration of the knowledge automation, with the action automation to develop the IPA, capable of performing the cognitive tasks needed to solve the business case. Besides this integration, the 5th step includes all phases regarding software-based automation development that organizations are familiar with, like testing and documentation;

6th) Deployment and Benefits Tracking: If the IPA's goal is to add activities that humans do not do due to high costs and effort, its deployment is easy because it does not interfere with actual processes. If the goal is to substitute human action, its use should be tested first in the production environment as a pilot without changing the course of actual processes. Depending on the business case complexity and the availability of a Digital Twin Organization (DTO), these tests can occur in the digital twin without any risk for business operations and customer service. Once the process owner business analysts are comfortable, the developed IPA can substitute actual human activities. Benefit Tracking can be done through workflow or BI platforms and it will enable making decisions regarding IPA adoption, development and scalability.

Communication platforms must be used to facilitate and enable proper and close communication and ensure collaboration between all functional areas involved in IPA development. There are two phases of communication, the first is related to the 1st step where companies can have a pre-team that knows well the business language only for needs identification and specification. Then, a second communication phase, across all other steps, where business users, IPA developers and IT will work the business needs.

It is also imperative to prepare BPM documentation and KM contents to communicate IPA developments and considering that organizations are working in an agile environment, all documentation should be digital and restricted to the essential to organizations' sustainability.

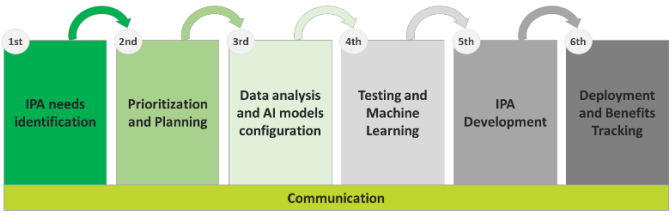

Figure 2. IPA Framework

V. Model and Framework Assessment

This scientific research considered a use case to demonstrate the solution proposed and an experts' analysis to perform its evaluation and revision.

Considering that a use case company in the energy market would implement the proposed strategic model and framework in their client servicing operations, the figure 3 describes an example of IPA opportunity in the "Manual Process" flow and

demonstrates the results of IPA creation in the "Intelligent Process Automation" flow.

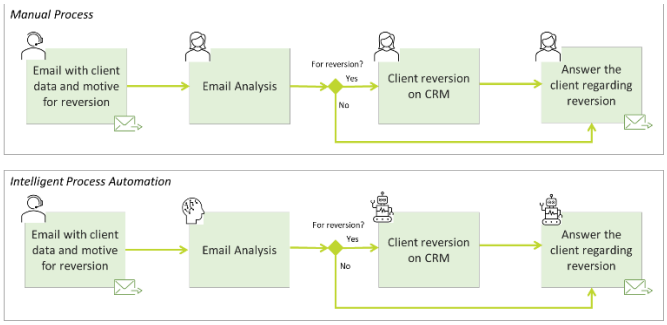

Figure 3. IPA creation example

To demonstrated how companies can accelerate their DT through IPA, the use case company was evaluated regarding their DT maturity, before and after hypothetical IPA implementation. In this evaluation was considered the information published on company's website [51] and the DT self-assessment questionnaire in [18].

Before implementation, from 15 to 154 points, the company got 100, and it was possible to identify some improvement aspects to work on through DT. After the hypothetical IPA implementation, to accelerate DT, from 15 to 154 points, the company got 125, 25 points more than before, demonstrating that the IPA strategic model and framework application have accelerated the company's DT.

An expert's analysis was conducted to evaluate the strategic model and framework proposed. These artifacts were presented to three IA experts that answered four quality evaluation questions. The methodology applied to these evaluation sessions was individual interviews accomplished between January 27th and February 4th. Each expert was interviewed individually and asked to accept the session recording to enable its transcription.

The expert interviews made possible a discussion regarding the artifacts' utility, quality, and contribution to companies' DT acceleration. A first result was the positive validation of the proposal, since the three experts considered the artifacts and essential to improve this academy and industry area of research. A second output was the revision of the first strategic model and framework proposed. Considering the experts recommendations and improvements, a better and final version of the strategic model and framework was designed and described in this study.

Overall, the use case and the expert's analysis have positively contributed to the validation of the proposed IPA Strategic Model and Framework.

VI. Conclusions

The presented study followed a DSR methodology to identify and propose a solution to solve the problem of lack of knowledge regarding how companies can implement IPA to accelerate their DT. A literature review was conducted, and, as a solution, it was designed, demonstrated, and evaluated a Strategic Model and Framework for IPA implementation.

The proposed solutions were demonstrated and validated by experts, considering their recommendations and improvements to present a final proposal. The limitations are mainly due to time and scope, since this study was conducted to complete a master thesis and is driven by its deadline. The implementation of the whole solution inside an organization would strengthen the results obtained.

For future work, an evolution of the proposed Model and Framework can be studied to introduce the orchestration of human and digital interaction and collaboration. It was also identified the need of study "How to develop an automation's business case that predicts and demonstrates its value for the organization?".

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