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# **Transforming Business Applications In SME By Implementing Low-Code/No-Code Development Platforms**

Pham Hoai Nam



A thesis submitted in partial fulfillment  
of the requirements of the  
Vietnamese-German University  
for the degree of  
Master of Business Information Systems

Research undertaken in the  
Business Information Systems Department

Supervisor: Dr. Said Zahedani

And

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February 2023

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1 February 2023

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Dear Dr. Said Zahedani

Enclosed is my master's thesis entitled "Transforming Business Applications In SME By Implementing Low-Code/No-Code Development Platforms" submitted to partially meet the requirements for the Master of Science in Business Information Systems.

This report describes how low-code/no-code platforms can contribute to the transformation of SMEs.



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I appreciate the time you are taking to review this Thesis and hope that it meets your approval. If you have any questions, feel free to contact me either by telephone: (+84) 975 073 650 or e-mail: [15663@students.vgu.edu.vn](mailto:15663@students.vgu.edu.vn) // [nam.ph@outlook.com](mailto:nam.ph@outlook.com).

Sincerely yours.

A handwritten signature in black ink, appearing to be 'Pham Hoai Nam', written over a horizontal line.

Pham Hoai Nam

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Date 1 February 2023.



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## List of Acronyms

No.	Acronym	Meaning
1	OS	Operation system
2	SMEs	Small and Medium Enterprises
3	IoT	Internet of Things
4	3D	Three-dimensional
5	PC	Personal computer
6	EA	Enterprise Architecture
7	ITIL	The Information Technology Infrastructure Library
8	SEO	Search Engine Optimization
9	API	Application Programming Interface
10	SaaS	Software as a service
11	PaaS	Platform as a service
12	IaaS	Infrastructure as a service
13	NLP	Natural language processing
14	LCAP	Low-Code Application Platforms
15	WFMS	Workflow management systems
16	BTS	Build-to-stock
17	vf-OS	The virtual factory open operating system
18	AI	Artificial intelligence
19	ML	Machine learning

# Abstract

## Transforming Business Applications In SME By Implementing Low-Code/No-Code Development Platforms

Pham Hoai Nam

Small and medium-sized businesses (SMEs) are crucial to inclusive and sustainable economic development. The significance of small and medium-sized businesses stems from their role as key generators of employment, economic development, and innovation. As the global economy confronts persistent problems, governments help SMEs to become an essential part of social cohesion. However, many conventional SMEs with a limited understanding of technology and fear of change impede adaptation and growth. Low/No-Code Development (LNCD) is an automated software development method that allows businesses to respond fast to market changes while requiring little or no code for automated application maintenance. We have examined the current market-leading LNCD systems in this report.

We have outlined the essential characteristics that an LNCD platform should possess and provide (developers' hub, open source, messaging, and Pub/Su (Pub/Sub is an asynchronous, scalable messaging service that decouples message-generating services from message-processing services.)) and determine that AI & ML is the key to advancing LNC technology. Then, the virtual factory open operating system (vf-OS) was compared to current LNCD platforms through benchmarking.

As a result, a list of findings has been prepared that emphasizes the absence of transversal platforms. In order to build ecosystems for the production and distribution of applications, among other things, these findings were founded on open standards. In addition, the usage of wizards that help developers through the various phases of development using a range of development tools may considerably enhance the user experience while creating new business applications. Based on our analysis of each component, we will play a significant role in the transformation of the digital world and generate a turnaround in the software development industry, especially for SMEs.

Key Words: Small and medium enterprises (SMEs), digital transformation, ecosystems, business application, low-code/no-code platforms.

# Chapter 1 - Introduction

The overwhelming majority of worldwide enterprises are classed as either small or medium-sized firms (SMEs). It is typical for them to be small businesses with less than 50 workers. Nonetheless, the maximum number of workers varies from nation to country. For the majority of businesses, the top range is approximately 250. In certain nations, the total number of workers is capped at 200. In the context of the economy of the United States, a "small and medium-sized enterprise" (SME) is a business that has less than 500 workers.

## 1.1 Application landscape for SMEs

Organizations are transforming with industry revolution 4.0 all around the world, moreover with all cross industries especially in COVID-19 pandemic period. They are trying to quickly implement evolving technologies in order to reduce business costs and enhance customers relationship by mainly digitalizing their internal processes which most focus on approvals and task management such as, quotation approval process, onboarding new hire, leave request... By investing in outsourcing with high cost and less extendable. SMEs are now exploring for Low/No-Code Development (LNCD) that will assist them in achieving their goals, while also being client-friendly and functioning on a variety of platforms including web browsers, Windows OS, Mac OS, mobile devices, and tablets.

Consequently, the goal of this research is to investigate for LNCD platforms which are mainly chosen and applied on SMEs business. This includes key factors for transforming businesses challenges and opportunities with digital transformation. To achieve the goal, several study approaches with practices build up applications or processes to handle businesses need. (Ulas, D. (2019). Digital Transformation Process and SMEs. *Procedia Computer Science*, 158, 662–671.)

### 1.1.1 Digital Maturity

In an ever-evolving and changing digital economy, McKinsey defines digital transformation as "the restructuring of technology, business models, and processes to generate new value for customers and employees." In actuality, the rate of digital transformation is dictated by customer demand. With optimum and quicker decision-making procedures based on numerical data at each phase of manufacturing, the time from product design to manufacture is shortened, the market entrance period is shortened, and a product range that fully satisfies consumer needs is feasibly made. This method increases the efficiency of operations and

reduces their expenses. Classic business models have been supplanted by knowledge-based, adaptable, instantaneously changing, and responsive to consumer preferences in real time business models.

Industry 4.0 has made the manufacturing process and production process more realistic, as well as other areas of manufacturing such as the supply chain, the cost of energy and infrastructure, the need for human resources, the number of qualified personnel, the amount of revenue and profit, etc. Those who are able to survive in today's constantly advancing digital environment are the individuals and businesses that are able to keep up with technology.

Internet of Things (IoT), robots, 3D printing, artificial intelligence, augmented reality and virtual reality (AR/VR), the next generation, security, simulation, horizontal and lateral software integration, blockchain, nanotechnology, cloud computing, and big data are examples of innovation accelerators that have propelled the pillars of digital transformation into widespread use.

#### **1.1.1.1 Accelerating Factors of Digital Transformation:**

The adoption of digital technologies inside a business is what "digital transformation" refers to. This has a huge impact on the operation of businesses and, ultimately, the value created for customers. In the past, digital transformation was a lengthy process that sometimes took firms months to complete owing to its complexity. The transition now may be done in a couple of weeks or even days. This is the digital transformation's part of acceleration. (Ulas, D. (2019). Digital Transformation Process and SMEs. *Procedia Computer Science*, 158, 662–671.)

##### **1.1.1.1.1 Innovation**

The use of new ideas fosters both technological progress and economic growth. An economy benefits from the combination of technological innovation and savvy policymaking. Programming and work on several digital platforms should be the major focus of a growing number of independent company entrepreneurs.

Small and medium-sized firms (SMEs) may profit from enhanced market intelligence and inexpensive, convenient access to worldwide marketplaces and knowledge networks, be possibly made by digital technology. (Ulas, D. (2019). Digital Transformation Process and SMEs. *Procedia Computer Science*, 158, 662–671.)

#### **1.1.1.1.2 Business's change**

As a result of the Internet, electronic commerce, and social media, traditional methods of doing business have undergone significant shifts.

Every day, millions of people use the Internet as a hub for business, education, entertainment, and socializing, all of which have significant effects on the economy of the United States.

In accordance with data from the World Trade Organization, 664 *Procedia Computer Science*, 158, 662-671, with Dilber Ulas (2019). Details of the authors / *Procedia CS 00* (2019) 000-000 3 To produce, distribute, sell, and transport goods and services through electronic networks is the essence of what we mean when we talk about "e-commerce." In its definition, the OECD includes "all sorts of transaction connected to economic activity, embracing both companies and people, based on the processing and transmission of digital data, including text, voice, and visual imagery."

Thanks to the digital revolution, which paves the way for the emergence of "born global" SMEs, small and medium-sized businesses (SMEs) may raise their competitiveness on local and global markets via product or service innovation and better manufacturing processes.

(Ulas, D. (2019). Digital Transformation Process and SMEs. *Procedia Computer Science*, 158, 662–671.)



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#### **1.1.1.1.3 Enhanced transportability of products**

Globalization include cross-border economic integration, national economies accessing the global market, and growing global community and government participation. (Ulas, D. (2019). Digital Transformation Process and SMEs. *Procedia Computer Science*, 158, 662–671.)

#### **1.1.1.1.4 Industry 4.0**

Industry 4.0 is ICT-enabled manufacturing. The fourth industrial revolution is anticipated to include automation, instantaneous networking, and custom production. Enhanced production and decreased waste of natural resources, such as electricity and water, have the additional advantage of reducing pollution. As digital factories enable more customisation, the production of goods for specialized markets will become more feasible. Also accessible are substantial energy cost savings. (Ulas, D. (2019). Digital Transformation Process and SMEs.



#### **1.1.1.1.5 Generation Z**

The market is influenced by Generation Z's desires as new consumers: Between 1996 and 2001, 25% of the global population was born. This generation, which was born into a digital environment, is fond of mobile devices, has been determined. Generation Z appreciates online connection, subscribes to channels with captivating videos, follows vlog trends, is concerned about viral marketing, and wants to develop goods. (Ulas, D. (2019). Digital Transformation Process and SMEs. Procedia Computer Science, 158, 662–671.)

#### **1.1.1.1.6 AI**

Human cognitive processes and the brain are used by artificial intelligence to solve problems. Instead of depending on the logic of the programmer, AI develops its own learning, understanding, and assessment capabilities. Robots with artificial intelligence perform industrial activities apart from humans. Software systems with artificial intelligence are capable of performing certain tasks and enhancing their performance over time. (Ulas, D. (2019). Digital Transformation Process and SMEs. Procedia Computer Science, 158, 662–671.)

#### **1.1.1.1.7 IoT**

With a basic explanation, the Internet of Things (IoT) enables the transmission of data from one device to another across the internet. It is a network of interconnected electronic devices, the most fundamental of which are sensors, and the most modern of which are smartphones and body-worn technology. When connected with automated systems, these devices may be used to expedite the completion of a task, the collection of data for analysis, the creation of an activity for the purpose of learning a method, etc. The Internet of Things enables advances in productivity, saves in time and money, and, most critically, reduced pollution. The Internet of Things (IoT) is a network of linked computer gadgets and other electronic goods that can send and receive data over the internet and exchange data with one another. (Real-time data collecting, monitoring, decision-making, and process optimization). (Ulas, D. (2019). Digital

Transformation Process and SMEs. *Procedia Computer Science*, 158, 662–671.)

#### **1.1.1.1.8 Blockchain**

Blockchain is a decentralized ledger that can be securely encrypted and shared. Blockchain, the underlying technology of Bitcoin (a widely recognised, decentralized digital currency that has existed since 2012), enables the encrypted monitoring of operations in real time. (Ulas, D. (2019). *Digital Transformation Process and SMEs. Procedia Computer Science*, 158, 662–671.)

#### **1.1.1.1.9 Cloud computing**

The distribution of information technology through the Internet is referred to as cloud computing. This is the core of e-commerce: the production, distribution, sale, and transport of goods and services over electronic networks. The Organization for Economic Co-operation and Development defines e-commerce as "all types of economic transactions between enterprises and individuals based on the processing and transmission of digital data, including text, audio, and visual images" (OECD). Due to the digital revolution, small and medium-sized enterprises (SMEs) have more opportunities than ever before to strengthen their competitiveness on local and global markets via product or service innovation and improved production processes. (Ulas, D. (2019). *Digital Transformation Process and SMEs. Procedia Computer Science*, 158, 662–671.)

#### **1.1.1.1.10 Increased use of mobile devices**

Over one billion mobile phones are sold annually on a global scale. The most cutting-edge smartphones nowadays are also capable of doing some light computing. Today, almost a quarter of all mobile phones in use are smart phones. Currently, 99 percent of Turks have access to mobile phones, 77 percent to smartphones, and 48 percent to personal computers. A total of around 59 million people, or 73% of the population, have a mobile phone subscription. (Ulas, D. (2019). *Digital Transformation Process and SMEs. Procedia Computer Science*, 158, 662–671.)

#### **1.1.1.11 3D printer**

The word "3D printer" refers to a machine that, without requiring a mold or fixture, can rapidly make computer- or 3D-generated models. From conception through manufacture, the price of a product has decreased. This increases production speeds. China's 3D-printed dwellings may be completed inside a day. It may be utilized in the design process to reduce the cost of molds, medical software, prostheses, plastic plasters, personalized presents, creating models, and developing robots, among other things. There are a variety of additive manufacturing techniques for making three-dimensional objects using 3DP. (Ulas, D. (2019). Digital Transformation Process and SMEs. *Procedia Computer Science*, 158, 662–671.)

#### **1.1.1.12 Chatbots**

By replicating human communication in both written and spoken forms, chatbots aim to assist consumers with customer service. Advanced examples of chatbots include Apple's Siri, Google's Assistant, and Alexa, which are all products sold by Amazon. (Ulas, D. (2019). Digital Transformation Process and SMEs. *Procedia Computer Science*, 158, 662–671.)



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#### **1.1.1.13 Big Data**

The phrase "Big Data" (BD) is used to characterize very large data collections that are beyond the analytical capabilities of the majority of current computers. Big data (BD) refers to a growing repository of diverse data kinds that may be mined for insights. Big data enables designers to better determine genuine demands from current data, hence accelerating the process of generating fresh concepts. Big data and analytics may tell small and medium-sized enterprises (SMEs) a great deal about their own operations, those of their customers and partners, and the status of their sector as a whole. (Ulas, D. (2019). Digital Transformation Process and SMEs. *Procedia Computer Science*, 158, 662–671.)

#### **1.1.1.14 Augmented reality**

As a technique, augmented reality (AR) refers to the process of augmenting one's perception of the actual world by the addition of artificial sensory inputs. Text, images, films, music, haptic feedback, Global Positioning System (GPS) data, and even olfactory data are examples

of virtual objects and materials that may be utilized to transmit data. In addition, there is olfactory data. Using it in industrial operations increases productivity and decreases expenditures. AR may be used to augment the user's experience of natural settings or scenarios. Innovative augmented reality (AR) capabilities (including computer vision and object recognition) make the physical world of the user dynamic and sensitive to their activities. The physical world is supplemented by information about the immediate environment and its contents. Virtual tours of completely digital assets are one use of augmented reality technology; the medical industry may use the same technique to conduct virtual surgical training and examine the anatomy of virtual patients. (Ulas, D. (2019). Digital Transformation Process and SMEs. *Procedia Computer Science*, 158, 662–671.)

#### **1.1.1.1.15 Increasing the use of the sharing economy**

Common terms in economics and popular press include "sharing economy," "collaborative economy," "digital economy," "circular economy," and "peer-to-peer economy." Using intermediaries and digital technology, the sharing economy can quickly and efficiently balance the supply and demand for idle resources. Consumers may also be involved in the producing process. In a sharing economy, we donate items that we no longer need to others who can put them to good use. (Ulas, D. (2019). Digital Transformation Process and SMEs. *Procedia Computer Science*, 158, 662–671.)

#### **1.1.1.1.16 Nanotechnology**

In the context of nanotechnology, the prefix "nano" refers to a magnitude one billion times smaller than the standard physical unit (N). There is currently no commonly accepted definition of the nano. Nanometers are the standard length measuring unit. Nanotechnology is mostly concerned with nanoparticles with at least one dimension between 1 and 100 nm. The minute size of a nanometer is readily evident when contrasted to the approximately 100,000 nanometers that comprise a human hair. (Ulas, D. (2019). Digital Transformation Process and SMEs. *Procedia Computer Science*, 158, 662–671.)

#### **1.1.1.1.17 Digital Supply Chain**

The phrase "Digital Supply Chain" (DSC) refers to a set of instruments (including computer programs, physical components, and communication networks) that are used to coordinate the operations of international enterprises. Purchasing, producing, storing, and transporting a product are covered. Fastness, flexibility, global connection, real-time inventory, transparency, intelligence, scalability, innovation, proactivity, and environmental consideration are the attributes that DSC values most when it comes to its business operations. (Ulas, D. (2019). Digital Transformation Process and SMEs. *Procedia Computer Science*, 158, 662–671.)

#### **1.1.1.1.18 Robotics**

Robotics use robots with increasing degrees of intelligence and capacity to automate operations and reduce the cost of human labor. More and more human work is being automated as the capability and intelligence of robots increase. Greater market adaptability and product delivery speed Self-driving automobiles, sensors and interfaces with improved materials and ergonomic design, and automobiles that need little human intervention. As a consequence of robots, the labor-to-capital ratio is altered, and social standards are modified. Diverse end-user industries are quickly embracing industrial robots to enhance product quality and save production costs. (Ulas, D. (2019). Digital Transformation Process and SMEs. *Procedia Computer Science*, 158, 662–671.)

#### **1.1.1.1.19 Cyber-physical systems**

CNC utilizes a variety of advanced manufacturing technologies, including cyber-physical systems, autonomous robots, rigid automation systems, intelligent sensors, and production systems (CNC). (Ulas, D. (2019). Digital Transformation Process and SMEs. *Procedia Computer Science*, 158, 662–671.)

### **1.1.2 Current situation of businesses processes**

Companies of all sizes and in all industries are increasingly providing their employees with a variety of technical tools. Today, more than half of all workplaces have Internet-connected workstations. The use of digital technology by businesses may provide substantial benefits.

Digitalization helps minimize transaction costs by simplifying and accelerating interactions between employees, suppliers, and networks. As a consequence of lower shipping costs and improved customs clearance processes, more small and SMEs are joining the global market.

This initiative improves access to government services, financial resources (including those supplied by peers), educational opportunities, and career opportunities. In addition, it allows businesses to gather data and examine their own operations in unique ways, both of which may result in greater productivity and enhanced creativity. The increased use of digital technology over the last decade has widened the gap between smaller (10 to 49-person) businesses and larger corporations.

During this time period, firm sizes in frontier nations such as Denmark, Finland, and Sweden have expanded rapidly, whereas in countries such as Portugal, Greece, Poland, Hungary, and Turkey, they have stagnated (the median proportion of small company employees having linked computers remains below 40 percent). As a consequence of digitalization's contribution to increased productivity and, therefore, wage growth, there has been a growing disparity in the economic well-being of various individuals, locations, and organizations.



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The first step is sometimes the most difficult for enterprises. After making the first move to digital technology, organizations often seek to build additional solutions that might aid in the maintenance of this transformation. While implementing new digital technologies, it is usual for SMEs to rely on external systems, guidance, and help. This is due in part to budgetary restrictions and a lack of required capabilities inside the business. Some activities (such as business intelligence (BI) and data analytics services) may be vastly enhanced (at a minimal cost) by using the capabilities provided by digital platforms (like social media, e-commerce marketplaces, etc.).

Similarly, SMEs address digital security issues by seeking the assistance of external specialists or by using the security-by-design elements that are included into the digital products and services they use. Knowledge exchanges also offer businesses with access to AI-based solutions, but cloud-based and SaaS apps allow them to circumvent less sophisticated AI-based systems. Technical complementarities may result in significant digital disparities since bigger and more technologically skilled firms may adopt more sophisticated digital

activities with greater ease.

When it comes to applying cutting-edge technology (such as data analytics) on a wide scale, small and medium-sized enterprises (SMEs) lag behind their bigger competitors (tools such as enterprise resource planning (ERP), supply chain management (SCM), and customer relationship management systems (CRM) promote the integration between the front office and the manufacturing process). The majority of SMEs begin their digital transformation in their back-office or marketing functions, where they already have a competitive advantage over their larger competitors in areas such as electronic invoicing, government interactions, social media marketing, and online sales.

### SME adoption gaps are substantial in several domains

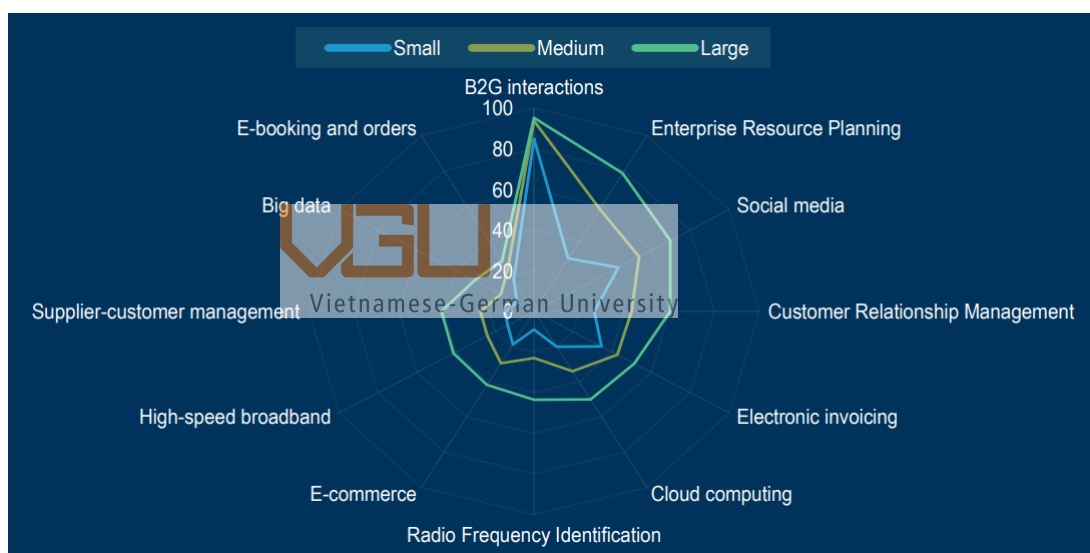


Figure 1 The median OECD diffusion rate is based on the average proportion of companies employing the technology in each country 2015-18

The values show the median of the diffusion rate distribution for nations for which data is available. From 2015 to 2018, national average diffusion rates are determined. This method is excellent for reducing short-term or annual distortions, but it may be too cautious for predicting the spread rate of rapidly propagating technologies. Only firms with at least 10 workers are included in this research. Companies with less than 50 workers are regarded to be small, those with 50 to 249 employees are considered to be medium-sized, and those with 250 or more employees are considered to be big. Estimates supplied by the OECD that were obtained from the OECD Database on ICT Access and Use in Business (accessible at

www.oecd.org/sti/ieconomy/ICT-Model-Survey-Usage-Businesses.pdf) (OECD, 2020).

In terms of the kind of personnel needed and the technology used, however, there are major disparities across industries. More than ninety percent of workers in knowledge-intensive sectors, such as information and communication services, utilize Internet-connected devices, compared to fifty percent of employees in all other OECD industries (OECD, 2020). Any industry that wishes to run correctly must adopt a variety of technology. When businesses such as hotels and restaurants lack access to high-speed internet, a website, and cloud computing (CC) for information storage, more value is generated, but the digital divide develops. For instance, e-commerce and cloud computing to host databases, as well as the education of information and communications technology specialists, are crucial for the retail sector. In contrast, e-commerce and cloud computing are increasingly crucial for the wholesale industry to handle customer relationships.

Therefore, governments should guarantee that all businesses, regardless of size, have access to the digital technology required to participate in the digital revolution. However, this technique must be accompanied with a strategy that emphasizes the most effective technology for the industry and the company's objectives.

## **1.2 Digital Transformation requirements**

Digital transformation encompasses not just the technology change of a company, but also the transformation of its culture. It is insufficient to just add technology to an existing strategy to alter it.

### **1.2.1 Digital transformation 4.0 for SMEs**

This is the last and maybe the most challenging phase in reforming a firm. The process of change is the way through which an organization undergoes transformation. Dawson (2003) provides a model in which the content, environment, and politics of change all contribute to the construction of transformation. The "politics of change" refers to the obstacles experienced during change, such as opposition to it, while the "content of change" encompasses not only the nature of the change but also its magnitude. Both are required for a comprehensive comprehension of the intricacies of organizational transformation and the barriers faced by various firms throughout the shift. (The Digital Transformation of SMEs | OECD Studies on SMEs and Entrepreneurship | OECD iLibrary. <https://www.oecd->



## **Types of organization change**

Depending on the nature of the perceived danger or opportunity, a business may select either proactive or reactive engagement. As opposed to reactive modifications, proactive ones are done prior to the actual occurrence of a problem. Reactive change gives a visible and palpable indicator of the need for change, but the velocity of that change must be evaluated to ensure that it is swift enough to meet external demand. On the other side, proactive changes may be seen as a forecast of the need for change; but, the needed actions and time to implement such changes cannot be predicted in advance. (Anderson & Ackerman Andersson, 2010; Hodges & Gill, 2015). The magnitude and frequency of organizational adjustments might vary substantially.

Some modifications are minor, such as improvements to extant operating systems; they are simple to implement, but do need thought (Boje et al., 2012). All of the changes that have occurred are motivated by the ongoing, ever-present, and ever-evolving pursuit of improvement. This kind of shift is differentiated by the fact that it builds on previous triumphs and may be seen as an ongoing improvement. It is claimed that 95% of all changes inside a company are modest (Burke, 2008). Other changes are more radical or revolutionary, necessitating a full reorganization of the whole business and, often, new cultural norms and values for the organization (Anderson & Ackerman Andersson, 2010).

Alternatively, little and substantial changes coexist. Long stretches of stability are punctuated by dramatic transformative upheaval (Gersick, 1991). Nadler and Tuschman (1989) created a model to investigate the connection between proactivity, reactivity, incrementalism, and radical change. Adapting to changing market circumstances is an example of incremental-reactive change, whereas incremental-proactive change is actively searching out chances to enhance current procedures (e.g. fine-tuning of operations). To bring about proactive transformational change, however, substantial changes must be made across the whole organization, including the culture, structure, strategy, and mission of the business. A reactive-transformational shift happens when there is a rapid reaction to an external or internal stimuli.

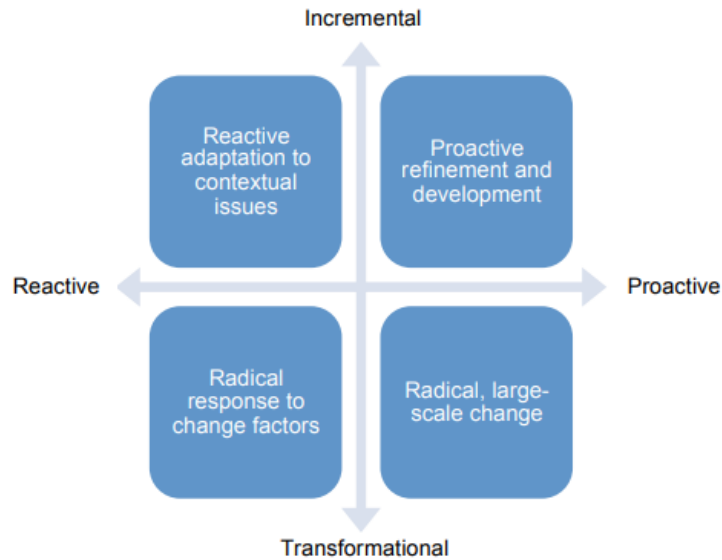


Figure 2 Change types in the workplace (Adopted from Nadler & Tushman, 1989)

### Opposition to alteration

Due to the difficulties of executing a change strategy, the academic literature has devoted a considerable deal of attention to this topic. Organizations fail for eight reasons, according to Kotter (1996, 2007): a lack of a strong guiding coalition, a lack of vision, a failure to effectively communicate that vision, a failure to remove barriers to the new vision, a failure to adequately plan for short-term successes, a premature declaration of victory, and a failure to firmly anchor changes within the company's culture.

Some individuals believe that change initiatives deserve credit for introducing fresh survival methods, while others claim that these efforts seldom succeed in altering the underlying character of the organization, resulting in the recurrence of the same issues (Weick, 2000). Hamel and Prahalad (1994) make a similar point, asserting that a typical cause of a company's demise is its senior management's erroneous confidence that prior techniques would continue to be successful in the future. They highlight two significant aspects that will influence future competition: Leaders of an organization must realize that change is essential for its sustainability. Second, businesses need foresight to influence the future business climate. This may be accomplished via developing new markets, services, and products.

Unfortunately, resistance to change is a typical factor in the failure of efforts to modify organizations. There is a potential that the proposed change would disrupt the stability of the

working environment and contribute to an atmosphere of uncertainty and ambiguity. This is one of the primary reasons why workers are resistant to organizational change initiatives. It is suspected that one or more of the following variables lead to resistance: A significant shift in the knowledge or skills necessary for success, the possible loss of one's job, an emotional or psychological danger, a change in how things are done at work, or a demotion are all examples of disruptive change (Dawson, 2003). Despite the assumption that leaders must imbue their workforce with purpose, confidence, and a desire to change, the human aspects of change are sometimes disregarded in change initiatives. (Hodges, 2016).

### **Problems posed by digital transition**

In addition to the many strategic problems that occur during a digital transition, there are other cultural and organizational obstacles that must be addressed (Bounfour, 2015; Collin et al., 2015). Notwithstanding the current scarcity of research on these 19 topics, it is very probable that the obstacles of digital transformation faced by SMEs are unique from those faced by bigger companies.

Nonetheless, the majority of small and SMEs have limits in terms of management, personnel, and financial resources (Ghobadian & Gallea, 1997). But they may adapt with the times and make hasty judgments, such as when to adopt a new technological innovation (Dangayach & Deshmukh, 2006). Small- and medium-sized company (SME) strategies are often reactive rather than proactive, informal, and changeable (Ghobadian & Gallea, 1997).

In addition, research indicate that SMBs often design ineffective methods (Singh, Garg, & Deshmukh, 2008). While a number of studies have explored digital transformation strategies for major enterprises, relatively few have examined the issue for smaller companies (SMEs). Li, Liu, Belitski, Ghobadian, and O'Regan found that the ability to combine business and digital strategy was connected with SME success (2016). It has been shown that SMEs that embrace digital strategies have a positive effect on innovation and global competitiveness (Fosty et al., 2013; Li et al., 2009).

Research undertaken on the issue of digital transformation in manufacturing indicates that small and medium-sized enterprises (SMEs) are prepared and able to adapt to the new business model; nonetheless, firm size has a significant impact. Smaller enterprises are more

likely to lose than to benefit from the planned industrial revolution (Sommer, 2015). Yet, there is a paucity of research on the methods followed by SMEs throughout their digital transformation. If SMEs in the manufacturing sector wish to understand more about the digital transformation process, the challenges they may encounter, and the justification for their involvement in the process, they may find organizational change theories useful.

### **The Covid-19 crisis altered the course of history:**

Due to lockdowns and social isolation, companies were compelled to perform a thorough examination of their operations. As a consequence, several organizations relocated their activities online or built clever working solutions to maintain company continuity despite supply chain interruptions (OECD, 2020). As much as 70% of SMEs have growth in the adoption of digital technology as a direct consequence of COVID-19, according to preliminary global business survey data. Several of these alterations are anticipated to become permanent due to the new models' investments and financial returns. Throughout the preceding months, business studies undertaken in various regions of the globe have all led to the same conclusion. In a poll done at COVID-19 in Brazil (Zdnet, 2020), more than half (550) of SME respondents cited improved customer connections, business agility, and client acquisition as digitalization's most significant advantages.



Seventy-two percent of Canadian small business owners with an online presence believe e-commerce is crucial to the success of their organization (Paypal, 2020). Nonetheless, many businesses lacked the time and knowledge necessary to competently manage this transition, including selecting the most appropriate digital systems, updating digital skills, constructing the most robust protections and security, and fully adapting to and appreciating the potential of these new technologies. The partial nature of the transfer heightens the hazards these companies confront. Unprotected SMEs are gravely threatened by the increasing sophistication of hackers (SMEs). Following the outbreak of COVID-19, the FBI's Internet Crime Complaint Center has received four times as many reports of cybercrimes. Very perhaps, the expenses involved with addressing a data breach would be too high for a small or medium-sized business to handle. The broad use of digital tools may have certain favorable characteristics, but attaining the technology's full potential involves overcoming considerable transitional obstacles, hazards, and opportunities as soon as feasible.

There still structural hurdles to surmount: Other structural barriers to digital adoption include:

- It is difficult for small and SMEs to get loans since their intangible digital assets cannot be used as security;
- A skills gap in the external environment that prevents managers and workers from identifying the digital solutions they need and adopting firm models and practices; and
- Lack of accessible cash, since small and SMEs are unable to get financing to finance expensive but transitory digital efforts. one that lacks the structure essential for stability. For small and SMEs to successfully migrate into the digital era, dependable, high-speed Internet connectivity is essential.

Since 2011, despite the fact that high-speed internet consumption has increased across the board in OECD nations, there has been a significant widening of the gap between the most advanced countries and businesses and the rest. The disparities have widened as a result of the inability of certain businesses and communities to modify their tactics and continue functioning despite protracted social isolation. Many nations, like Denmark's SME Digital initiative and Australia's Small Business Consulting Service, provide financial assistance and consulting services to help small businesses overcome these obstacles.



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In a number of nations, opportunities exist for SME to increase their level of competence. Countries like as Iceland and Costa Rica are planning infrastructure enhancements, while Germany, Belgium, and others are working on interconnectivity initiatives. It is necessary to have multilevel governance and mechanisms that connect thematic investments in order to properly coordinate these operations if we are going to be successful in closing the digital divide (for example ensuring that the provision of infrastructure is supported by training and advice to enable their use).

### **1.2.2 Executive Sponsorship**

Executive sponsorship promotes the development of SMEs, develops fair and ecologically responsible urban settings, and accelerates economic expansion.

#### **Boosting the internal capabilities of SME**

- SMEs get technical support and assistance via targeted financial aid (consulting vouchers, grants) or technology extension initiatives (diagnostic, self-assessment tools, e-business solutions, coaching, and a library of learning resources);
- There are many ways to encourage training and skill development in SMEs, including:

enhancing managerial capabilities in SMEs (via training, workshops, and coaching programs, and by increasing demand for these programs); reducing training costs (via, for example, tax incentives and subsidies); and promoting training in the workplace (via, for example, employer networks and organizations or intermediary "brokers" and apprenticeships proponents);

- Improving the data management and security of SMEs by enhancing their data literacy (through education, finance, and technical assistance);
- Digital security toolkits, audits, assurance framework, procedures, certification schemes, and instructional materials are excellent means of communicating to SMEs the need of maintaining a secure online presence.

### **Simplifying the usage of essential resources by SMEs**

- Encouraging the use of mobile banking or alternative data for credit risk assessment, particularly for small- and medium-sized businesses (SMEs);
- Encouraging corporate innovation and the dissemination of innovative digital solutions for digital security, blockchain, artificial intelligence, etc. through research grants, public procurement, tax incentives, demand-side regulation, competence centers, public-private partnerships, etc;
- SME-led public procurement, collaboration projects with big corporations or online platforms, and networking interfaces such as digital innovation hubs, centers of excellence, clusters, and co-working spaces provide SME access to knowledge networks;
- Data centers, digital innovation hubs, university transfer offices, co-creation platforms, etc., provide access to knowledge and resources that may be advantageous for SMEs.

### **Transforming SMEs through fostering the optimal business environment**

- Increasing efforts to ensure trade secrecy and intellectual property rights are protected uniformly across jurisdictions; enforcing data protection laws; developing industry standards for digital security; addressing regulatory concerns with distributed ledger technologies; and ensuring the smooth operation of knowledge markets in which small and medium-sized businesses (SMBs) can compete;
- Electronic invoicing, electronic signatures, and electronic submissions (such as tax

administration and default compliance); usage of emerging digital technologies in public services (such as blockchain, artificial intelligence, open government data, and so on); and so on.

- Creating infrastructure development plans and road maps to provide an interoperable public-private blockchain service architecture (for instance, expanding access to high-speed internet and connection in underserved regions).

### **Promoting a nationwide approach**

- Establishing broad goals and pillar concepts; Formulating national plans and policies;
- The development of authorities and organizations charged with monitoring the growth of policy in new domains such as artificial intelligence and blockchain technology;
- To support responsible and ethical digitization policies, consultative instances and advisory groups comprised of experts, entrepreneurs, business leaders, academics, and municipal authorities must be established at the national and subnational levels.



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# Chapter 2 - Challenges of SMEs in order to apply Digital Transformation

## 2.1 Decentralized system data

The current technological revolution is propelled by the information revolution.

There is always something worsening in the business sector, regardless of the kind of company you operate. While expanding your database is vital for your company's prosperity, it also makes you more susceptible to external threats.

As a result of digital disruption, the quantity of data created and used is expanding at an astonishing pace. In the next five years, IDC expects that digital data generation will outperform data creation since the introduction of digital storage by more than two to one. Nonetheless, there is a second reality underneath these frightening figures. (Shah, M. (2022, April 18). Council Post: A Decentralized Approach To Database Management. Forbes. <https://www.forbes.com/sites/forbestechcouncil/2022/04/18/a-decentralized-approach-to-database-management/> )



## The Use of Outdated Database Management Systems Is Becoming Superfluous

Conventional database management systems' foundation for storing, retrieving, sharing, and disseminating data is becoming antiquated. While multicloud solutions like MongoDB may provide the impression of data security and integrity, the reality is far different.

The current state of legacy database administration has led to the development of siloed systems, which in turn has led to increased vulnerability and a dearth of data assets under the direct control of their owners. Common internet design, sometimes known as Web 2.0, has put sensitive information at risk.

The promise of Web3 is a decentralized internet that will shake up how people and corporations deal with information.

## 2.2 Lack of architecture blueprints for businesses

Gartner defines corporate architecture (EA) as "a discipline for proactively and thoroughly directing enterprise responses to disruptive forces by defining and analyzing the execution of change in the direction of desired business vision and objectives." EA offers business and IT leaders with ready-to-sign recommendations on how to adjust policies and programs to meet



desired business objectives and take advantage of opportune business disruptions, hence delivering value.

EA is not intended to be obscured by arcane concepts or technical terminology. SCRUM, ITIL, cookies, spam, malware, netiquette, microblogging, SEO, API, caching, virtual, firewalls, routers, Bluetooth, API, SaaS (PaaS & IaaS), NLP, and waterfall are just a few of the ways we often use. There is no need to view EA as yet another abstract theory. EA should also not be conducted in a vacuum or by suppliers unfamiliar with the organization. It should not be difficult to understand and should not be separated from the rest of the company's strategy, which includes present and future models and procedures.

Clarifying the situation is the first order of business. Any and all abstract concepts, including "architecture," should be rewritten in language that are more accessible to a wider audience, particularly those who are not technology executives. Perhaps the terms "business strategy," "IT strategy," or "enterprise planning" would be more appropriate (BTS). Why? As the term "Enterprise Architecture" simply refers to the process of ensuring that the goals of the company and the means by which technology may facilitate those goals both now and in the future are in sync, it is only an alignment exercise. Since corporate needs are always evolving, this process never ends. Overall, EA converts strategy and connects people to technology. The Business-Technology Strategy represents the compromise.

If the benefits to your company can be quantified, then BTS is definitely worthwhile. We've been working toward the ideal of harmony for a long time now. It has not disappeared. Never go, since it's always right here. Equal justice and harmony are key to BTS's ethos. Companies, strategists, and technologists that didn't fully understand EA were forced to use the methodologies, tools, and frameworks that had been established over the years. The moment has come to boil down enterprise architecture to its essential features, namely, the integration of business objectives with technological goals. We could make things more difficult for ourselves, or we could accept that what we really need is a dynamic business technology strategy that will help us bring together the worlds of business and technology. Even while EA seemed like a good concept at the time, it ultimately proved to be impractical. Better outcomes may be expected with BTS.

The absence of clear corporate goals and process models has been the subject of a great deal of research. Several proposals have been made to include textual and graphical methods into process and workflow models in order to realize strategy. It is important that the available techniques not be too generic if they are to aid in the effective development of the alignment of corporate strategy with EA. However, no universal approach exists to demonstrate how this integration might be modified to many contexts and fields (Lederer et al. 2014)

Insufficient Access to Qualified Architects. There is a critical shortage of skilled enterprise architects (Armour et al., 1999a; Lam, 2004; Seppanen et al., 2009) because "competent architects are on high demand" (Seppanen et al., 2009). Similarly, to how complicated the area of EA is (Armour et al., 1999a; Dreyfus, 2007; Lam, 2004), so too are the EA frameworks that are often used (Schekkerman, 2004). As a result, the EA setting has a steep learning curve; as one author put it, "the limited period for learning and becoming familiar with the frameworks and governance model is a major obstacle for EA implementation" (Seppanen et al., 2009). Professional architects are not enough of a resource (Armour et al., 1999b).



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### **2.3 Lack of Planning and Implementation resources for SME**

However, "high failure rates and low performance levels" mean that SMEs aren't often recognized for their successes (Jocumsen 2004, p.659). Consistent growth of the industry requires insight into what sets certain SMEs apart from others. Analysis of the literature on small and medium-sized enterprises (e.g., Lurie 1987; Schwenk & Shrader 1993; Miller & Cardinal 1994; Hormozi, Sutton, McMinn & Lucio 2002) reveals that strategic planning is either absent or present as a critical factor of company performance.

According to the literature (Stonehouse & Pemberton 2002; O'Regan & Ghobadian 2004), strategic planning entails three main activities: the formulation of long-term organizational goals, the creation of actionable plans to realize those goals, and the reallocation of resources to make those plans a reality. Competitive advantage is at the heart of strategic planning. Ohmae (1983, cited in O'Regan and Ghobadian 2002, p.664) said it best: "the aim of strategic planning is to allow a corporation to obtain as effectively as feasible, a durable advantage over its rivals."

There is actual evidence to back this claim. Strategic planning is often more prevalent in high-performing SMEs, and this correlation holds true when examining their performance metrics. Strategically planning small and medium-sized enterprises (SMEs) have been shown to outperform their non-planning counterparts in many respects, including revenue growth, asset return, profit margin, and headcount expansion (Bracker, Keats, & Pearson 1988; Berman et al. 1997; Carland & Carland 2003; Gibson & Casser 2005).

Strategically planned small and medium-sized businesses (SMEs) are more likely to be creative, have freshly patented goods, use cutting-edge process and management technologies, and expand internationally (Upton, Teal, and Felan, 2001; Beaver and Prince, 2002; Stewart and O'Connor, 2005). In particular, small and medium-sized enterprises (SMEs) that practice strategic planning have a lower risk of failing (i.e. being voluntarily dissolved) (Gaskill, van Auken & Manning 1993; Perry 2001)

## **2.4 Reinvestment mindset**

According to the research, one in four small enterprises in the UK attribute their success mostly to the reinvestment of profits. The top 10% of performing companies re-invested an average of 9% of their earnings, which was shown to be correlated with medium-term sales growth.

As the managing director of consulting business Bulletproof Business Services, Jamie Keeling, put it, you must be prepared for when the proverbial "stuff hits the fan." Investing in the company is a terrific idea, but you must be prepared for when the proverbial "something hits the fan."

This last half year has shown that "if you've been reinvesting everything into the growth of the firm and reinvesting all of your earnings, then something like this happens, it may sometimes strike you harder than you expect."

However, the director of client services at SME Strategies, David Eaton, argues that reinvestment estimates must be account-specific since reinvestment rates would vary from firm to company.

Eaton argues that companies should have a frank discussion regarding their income, expenditures, operating costs, debts, and investments before making a decision to reinvest revenues in any way. (11. Shannon Moyer (2020, September 4). Profit reinvestments drive

SME growth, study finds - The CFO. The CFO. <https://the-cfo.io/2020/09/04/profit-reinvestments-drive-sme-growth-study-finds/>)



# Chapter 3 - Low code/no code approach to address Digital Transformation challenges

## 3.1 Introduction to low code / no code

A Low-Code/No-Code Development Platform (LCDP) is a system that facilitates the development of software for both online and mobile platforms without the need for extensive coding knowledge or expertise on the part of the user. The focus is shifted from coding by hand in traditional programming languages to using GUIs, pre-built modules, and configuration files. Developers employ visual designs, declarative languages, high-level abstraction, and hand-coded implementations to build user interfaces, business logic, and data services. Lessening the need for labor-intensive hand-coding allows applications to be delivered more quickly and at cheaper cost. The majority of LCP users, known as Citizen Developers, are domain experts who aren't familiar with programming. The success of an LCDP, as seen by the citizen developer, is contingent on its simplicity and ease of use. (Khorram, F., Mottu, J. M., & Sunyé, G. (2021, January 1). Challenges & opportunities in low-code testing | Semantic Scholar)



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As a result of rising demand, more and more low-code development platforms are now at developers' fingertips. These systems improve product quality and save development times by bridging the communication gap between business and IT by replacing manual operations with automation. Regardless of the tool or platform employed, testing must be performed on the system to ensure that all requirements are satisfied. To provide the highest level of confidence in the final product, the system development and testing process must take into consideration the characteristics of each development style, including low-code. Citizen developers play an important role in low-code development platforms, but their lack of technical IT knowledge adds extra requirements and hurdles for system building and testing.

Many commercial LCDPs have succeeded despite encountering obstacles, but these instances are constrained by vendor lock-in. Low-code testing refers to the testing methodologies that take into consideration the low-code environment, although you may purchase a product that does the same function. Since the quality of a system produced with an LCDP must be ensured, a low-code testing component is crucial for LCDPs. We were unable to find any literature that describes the features of this kind of testing component or suggests how it might be built. Mary Shaw categorizes the stages of research in software engineering, and she

classified low-code testing as "basic research" since the ideas, concepts, and research difficulties in this domain are so novel and undeveloped. This investigation was driven by the insufficient availability of low-code testing resources.

Power Apps LCDP is a service created by Microsoft that allows for the quick construction of online and mobile applications by use of a collection of apps, services, connectors, and data platforms. PowerApps uses a dual strategy in its design:

- Canvas-based: The user simply drags and drops components onto a blank canvas to create the program. Logic is defined using Excel-like expressions, and business data may be incorporated from a variety of Microsoft and third-party sources;
- Model-driven: This is a component framework that can be used by experienced developers to build and deploy bespoke components in applications.

The Power Apps Framework contains a broad variety of testing tools to support its diverse design strategies. A specific test studio is established to enable automated end-to-end testing of the user interface of canvas-based applications. There are two ways to generate test cases: manually using Power Apps expressions or automatically with record and playback. Easy Repro3, a framework for model-driven testing, simplifies the testing of Microsoft Dynamics 365 applications.

Because UI tests are developed with this tool without relying on parsing HTML components, they are more resistant to changes in the underlying markup. As a .NET mimicking framework, Fake Xrm Easy4 may be used in conjunction with other .NET testing frameworks for Power Apps' server-side testing, and the framework is compatible with current testing tools.

	<b>Low-Code</b>	<b>No-Code</b>
<b>Primarily Serves</b>	Developers	Business Users
<b>Primarily Objective</b>	Speed of Development	Ease of Use
<b>Coding Need</b>	Low, but present	No Coding Required

<b>Customization</b>	Total customization available	Pre-built templates can be customised
<b>Platform Lock-in</b>	Free to move between platforms	Sometimes locked into the same platform
<b>End-to-end Development</b>	All platforms provide end-to-end development	Some platforms provide only limited capabilities
<b>Purpose</b>	Next-gen Rapid Application Development tool for professional developers	Self-service application for business users
<b>App Complexity</b>	Can create complex apps	Can create simple apps
<b>Cost Effectiveness</b>	Cost-effective for companies with an existing team of developers	Cost-effective for companies with a backlogged IT team and high requirements

Table 1 Differentiating low-code from no-code



In this paper, we use LCDP to improve small and medium-sized enterprise (SME) procedures and locate low-code transformation possibilities.

### 3.2 Automation benefits of low code/no code

Many studies have shown that company owners put in double the hours per week as their salaried counterparts. Most of them work 60 hours or more per week. Not one person can possibly do everything that has to be done. (2022, April 4). Council Post: How SMEs Can Leverage Workflow Automation. Forbes.

<https://www.forbes.com/sites/theyec/2022/04/04/how-smes-can-leverage-workflow-automation/>

By automating routine tasks, company owners may devote more time and energy to growing their enterprises. Automating monotonous activities is only one way that technology is freeing up company owners to concentrate on what they do best: expanding their operations.

Automation of business processes also helps companies save money. Automated procedures are often more productive and less error-prone than their manual counterparts. This implies that by automating mundane processes, firms may save both time and money.

Ultimately, workflow automation is a helpful resource for enterprises of all sizes. It may help them save money and time, and concentrate on what they do best. Automation of your firm's workflows may help you save time and money as a small business owner.

### **Automating Lead Qualification**

Lead qualification is crucial to success, but it may also be time-consuming. Businesses may save time and effort by using lead qualifying systems that are fully automated. Without the need for coding or designing knowledge, no-code funnel builders enable organizations to quickly and easily develop surveys, quizzes, calculators, and payment sites.

As a result, small and medium-sized businesses may simply and rapidly ascertain whether or not a lead is qualified and has an interest in their goods or services. Prospective clients' contact details and purchase intent may be gathered in a sales funnel.

In a nutshell, sales funnels are an effective method of qualifying leads. They make it simple for organizations to ascertain whether or not a lead is qualified and interested in their goods or services.

### **Sales Automation**



Traditional sales procedures are laborious and often put too much stock on the individual's gut. Because of this, expanding a business's sales force may be challenging. The use of automated sales procedures may assist companies of any size deal with these difficulties.

A more efficient sales process is possible with the help of automated sales procedures, which use the use of technology to improve productivity. When it comes to assisting clients in making product purchases, interactive material may be very useful for companies. Using this method, we can tailor the information we provide to each individual client, guaranteeing that they get expert guidance.

It is simpler to collect money from customers because to the streamlined nature of automated sales procedures. PayPal, Stripe, and Mollie are just a few of many payment processing platforms that may be integrated into web sites to facilitate instantaneous and secure consumer payments.

### **Email Automation**

The use of email has not yet died. In fact, when it comes to reaching out to consumers, email



is among the most efficient channels available today. Using automated email procedures, companies may instantly and automatically send emails to their clients with tailored messages. Without having to create any code at all, companies may now maintain frequent communication with their clientele.

### **Onboarding Automation**

Getting a new client set up may take a considerable amount of time. Automation of the onboarding process results in financial and time savings. Things like taking orders, creating accounts, and letting people in are all examples of how data may be collected and used in this way.

Automated onboarding has the potential to be a positive experience for customers. This is because they won't have to bother calling in to customer support to get started. Also, this expedites the process of getting them the accounts they need and the services they need.

### **How Big Data Is Transforming Automation**

All the applications I've described so far need data collecting in one form or another. This is because information is crucial to the achievement of any robotic activity.

Business-generated data sets are sometimes referred to as "big data" because of their massive size. There are several ways in which this information might help enhance company operations. Use cases include consumer profiling, tracking client activity over time, and improving the quality of interactions with customers.

Any kind of automated operation can't function without massive amounts of data. In order to train and perfect their automation solutions, businesses require access to massive amounts of data. Surveys, quizzes, contact forms, and even online checkout pages may all contribute to compiling this information.

### **Where To Start**

Workflow automation implementation has proven difficult in the past. In order to get off the ground, companies have had to employ programmers and designers. Because of this, huge corporations with vast funds enjoyed a distinct edge over their smaller, more nimble competitors.

This, however, is beginning to change. Thanks to technological advancements, companies of every size may benefit from automating their workflows. Particularly, automating customer interaction, lead qualification, and email marketing may aid organizations of all sizes in automating their sales process.

However, there are some additional considerations for firms to make before taking off. To begin, it's crucial to think about the company's top priorities and design the automation system accordingly. As a second point, companies should not have unrealistic expectations for what automation can accomplish for them. Instead, then trying to automate everything at once, focus on one or two critical steps and build from there.

When an organization has deployed automation and articulated its objectives for doing so, it may begin monitoring its performance. In order to do this, there are a number of methods that may be used, the first of which is to establish conversion targets. That way, firms can track how well their automation is going and tweak it as needed.

Workflow automation is advantageous since it can be modified to suit businesses of varying sizes and operating in different sectors. There is a significant probability that automation may help you optimize your sales process and acquire a competitive advantage, whether you are a small firm just starting out or a major organization.

### **3.3 Requirements for low code/no code solutions**

#### Partitioning the Workflow Model

The primary purpose of a workflow management system is to promote the methodical and orderly completion of corporate operations. In a similar manner, a workflow modeling framework should take into account the techniques and tools used for documenting, analyzing, and summarizing the coordination of activities. (Sadiq, W., & Orłowska, M. (2000, January 1). On Capturing Process Requirements of Workflow Based Business Information Systems | Semantic Scholar. <https://www.semanticscholar.org/paper/On-Capturing-Process-Requirements-of-Workflow-Based-Sadiq-Orłowska/6d5effdee9bcb0c5120887d7c9787bbc3810fbd9>)

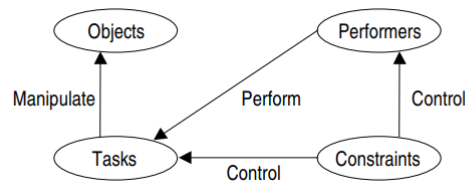


Figure 3 Workflows building blocks

Objects, tasks, actors, and restrictions are the four components that make up a workflow application. The nature of the application is determined by the aggregate characteristics of these four parts.

In order to describe these four components, we employ the term "labor." - Objects are the target of labor. Basically, everything that catches your eye qualifies as an item. The work that has to be done is outlined in the tasks. Most of the time, the actions required by tasks are carried out either directly on objects or with reference to data extracted from those things. Work is done by actors. Tasks are unable to carry out their duties autonomously.

They need the expertise of artists. — Proper completion of the task is governed by a set of constraints. What has to be done is laid down in tasks, and workers carry them out.

Constraints put in place to guarantee proper execution of the task at hand. The purpose of this article is to provide a methodology for documenting the information needs of an enterprise system, with a special focus on workflow. That is, remembering the fundamentals of the four pillars we just discussed. The completion of tasks is governed by a workflow management system. Observing the restrictions block in Figure 3 reveals that this coordination is contingent on its presence. The artists do the work within the parameters you've set. Consequently, one of the main goals of process modeling is to record and guarantee accurate limitations.

Workflow models may be made more comprehensible and less time-consuming to create by breaking down the modeling process into distinct sections. Utilizing a layered modeling method, we are able to capture and analyze modeling data at each level. The collected needs from each stage might be incorporated into one comprehensive process model in the future.

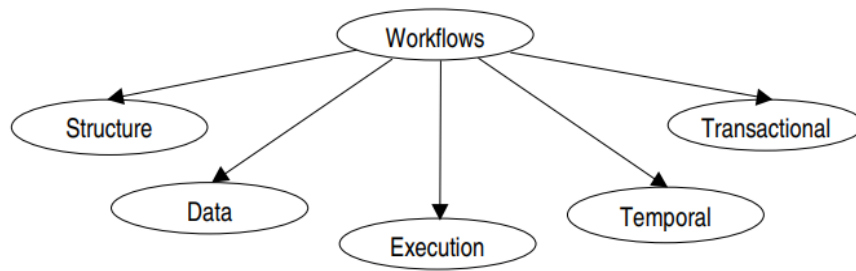


Figure 4 Divvying up the workflow model

This suggests separating the modeling process into five distinct phases: structure, data, execution, time, and transactions. Below is a summary of the data obtained at each step of the operation.

### Structure

In the context of a business, "workflow" refers to a series of operations carried out to achieve certain objectives. Typically, the commencement of one activity within a process will depend on the finish of a sequence of previous events. Thus, operation order is essential. Initially, we utilize this modeling strategy to identify when tasks change.

The recommended sequence and schedule of the workflow management system are decided by its structural modeling. This is the foundation of a workflow model and paves the way for recording other process requirements. Because they facilitate understanding, information modeling methodologies often include graphical representations. Similarly, visual items might be utilized to convey a process description. Here, we give a brief introduction of the structural characteristics and graphical representation of our workflow modeling language. The concepts behind this language's syntax may be found in the Process Management Coalition's generic workflow modeling reference. The reader is directed elsewhere for a more comprehensive explanation.

This graphical language uses node and control flow diagrams to illustrate processes. A node may be further classified as either a task node or a condition node. In this graphic, each rectangle represents a task that must be completed in order to achieve a goal. Additionally, it

is used in the development of concurrent, asynchronous, and synchronized systems. It is the primary topic of conversation when discussing workflow characteristics, and it may represent either human or robotic labor. Performers do fulfill their assigned duties. Circular circumstances are used in the construction of or-split and or-join structures.

Control flow is represented as a directed edge between two nodes in a graph. Workflow graphs are directed acyclic graphs (DAGs) in which nodes represent vertices and control flows represent directed edges, and they may be formed using any of the five modeling frameworks shown in Figure 5. Nodes will now be referred to as vertices, while flows will be referred to as edges.

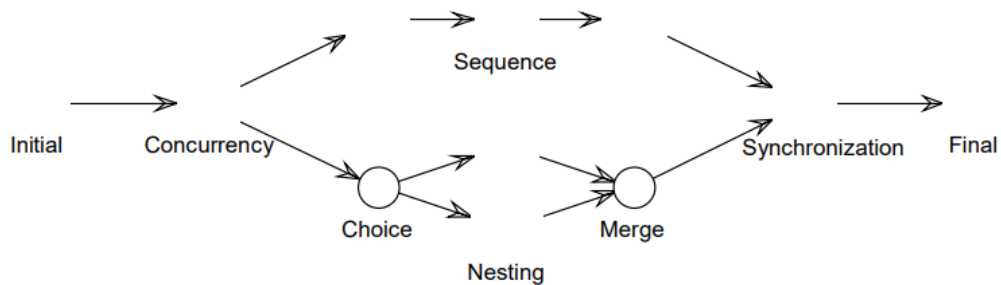


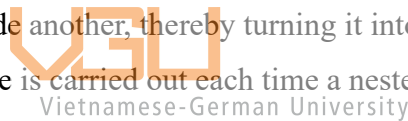
Figure 5 Workflow modeling structures  
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The sequence modeling structure describes the order of task execution and is the most fundamental modeling structure. It is built by linking a single entering flow and a single outgoing flow to a single action. A workflow graph's concurrency structure is given by detailing the interactions between several incoming flows and tasks. In order to continue with a process at a certain point, it may be necessary to await the results of more than one possible course of action. To coordinate several concurrent routes, a synchronization structure is used, which is represented by multiple incoming flows to a single job.

Synchronization cannot begin until all incoming flows have been initiated. A choice structure, constructed by connecting two or more outgoing flows to a condition object, represents an option that cannot be selected simultaneously. The workflow activates one of the choice condition object's outgoing flows during runtime, hence picking one of multiple possible business process execution pathways. The system of options is comprehensive and closed. The exclusive property guarantees that only one of the possible directions will be taken.

The completeness attribute ensures that at least one of a condition object's outgoing flows will be initiated upon activation. One may argue that merge structures are the polar opposite of choice structures. A condition object may be coupled with one or more incoming flows in order to integrate two or more pathways that would not be compatible without the condition object. Due to the nature of the directed acyclic graph (DAG) used to describe a workflow model, there must be at least one node in the DAG without any associated flows (a sink) or sources (a node with connections) (sink). These are the "root" and "tip" nodes of a network. The workflow graph's end node may be uniquely identified after all split structures are joined. Workflow graphs have just the one beginning and ending node.

When the last node in a workflow has finished running, the instance as a whole has completed its execution. The iteration structure is essential for modeling the recurrence of a sequence of steps in a process flow. Building blocks are used to represent the iteration process. The workflow's subgraph is iterated as long as the condition remains true. Through abstraction, the nested structure simplifies the process requirements. With this mechanism, we may nest one workflow definition inside another, thereby turning it into a task that can be used elsewhere. The underlying procedure is carried out each time a nested task is run.



There are four main types of workflow control structures, as described by the Workflow Management Coalition: or-split, or-join, and-split, and-join. Our model depicts these features using dedicated choice, merge, concurrency, and synchronization mechanisms. To represent the logic behind the many possible outcomes and their combination, we have the condition object. The synchronization and concurrency mechanisms are expressed by a direct connection of flows to tasks. This method enables for the clear description of workflow structural models while also reducing the amount of modeling items. However, there are circumstances when it is necessary to utilize null tasks whose sole function is to ensure flow is coordinated and that workflow structures are syntactically accurate.

## **Data**

Typically, workflow tasks are designed and carried out outside of the workflow management system. Control flow requirements represent the interrelationship between these activities. Also, even though the control flow between tasks is specified, there may be an underlying

data dependence between them.

When one job, T1, depends on the output or provision of data from another, T2, it is said to be "data reliant" on T2. An information flow is used to represent this kind of connection, and it lays out the steps involved in moving data from one endpoint (T1) to another (T2). In Figure 1, we see the performers whose responsibility it is to carry out the tasks. In the course of their execution, tasks may change the state of some objects. Performers utilize or create data on the items they are working on as they carry out their jobs.

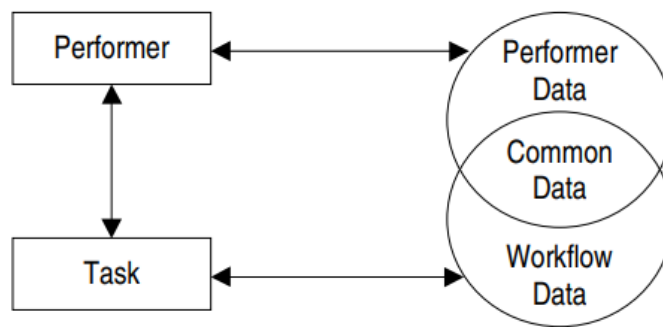


Figure 6 Task and performer data relationship



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We divide this information into three distinct types: performer information, workflow information, and performer information that is unique to the process. The workflow application will not have access to the performer's data until the performer deliberately makes their information available to the workflow management system (WMS).

By capturing and storing workflow-specific data internally, WMS coordinates the planning and execution of operations. There is a common subset of workflow and performer data known as workflow specific performer data. This uniformity of data features enables communication between the artists and the workflow management system. Figure 6 illustrates this connection. Significant dependence exists between the workflow model's structural and data components. To choose the alternative route, the condition object must have access to the data flow's data parameters.

There must be a control flow channel for data flow limitations between activities. We can mimic data flows by employing global process variables. The input and output containers for

each job are uniquely named. Tasks have an underlying application component that can read variables from and write to the task's input and output containers. An indirect method of mapping task variables to one another is to utilize the global workflow variables that correspond to the variables stored in these task containers.

## **Execution**

The workflow model's structure and data are used by the workflow engine to plan out the steps of the workflow's execution. The task scheduler, which is integral to the workflow engine, is what does this scheduling process. The task scheduler decides who will do what and when. The execution part of the architecture captures the modeling information for individual tasks that the workflow management system requires for task allocation.

Figure 6 depicts the delegation of responsibilities for task completion from managers to the performers who will actually do the work. We divide labor into two groups, robotic and human. The term "automation" refers to the process of having a computer carry out a job entirely on its own. Having knowledge of the protocol through which the workflow management system may interact with the underlying computer program is essential for the successful completion of such a job.

Human-oriented tasks are those that need the intervention of actual people, however they may also make use of some type of computational resource. The WMS would also need insights about the person responsible for the task, such as that person's job description and any relevant expertise. A workflow may be encapsulated in a task using the nesting structure and then reused in other workflows, as was previously explained. With the atomicity feature, you can tell which jobs can be broken down into workflows and which can't. From the perspective of a WMS, a single task is an atomic task.

In order to finish a nested job, the activities included inside the process it contains must first be carried out. An atomic job may be more involved than a nested task, however this is rare. That is workflow-specific. However, we refer to it as an atomic job if and only if it does not break down into a process. There are two kinds of work to be done: those that are external to the scope, and those that are inside. The first kind accounts for the vast majority of activities detailed in a workflow's standard. Any operation, whether automated or human, undertaken



outside the company in order to achieve an inside goal is considered an external job. Internal tasks in a workflow management system are those that are carried out in order to facilitate the completion of other tasks, either internal or external. Task allocation may need to be authorized in particular processes.

The workflow software used for this kind of procedure has to have the option to restrict task execution to approved individuals. These permissions are modeled together with other components of the execution process. Workflows also have the useful property of decentralizing the assignment of tasks to several agents. Performers are enlisted to assist in the completion of tasks. It is considerably more crucial to have efficient job allocation procedures when a big number of people are involved in performing a workflow application. For instance, a group of performers may exist who are capable of carrying out a certain activity.

Several factors might be taken into account while deciding which performer would be most suited for the job. Example: ensuring that all performers are receiving a reasonable share of work. These regulations may have numerous moving parts and restrictions on how tasks are assigned. During the modeling phase, it is crucial to record and examine the rules governing how tasks are divided up.

### **Temporal**

Workflow task scheduling now has an additional dimension, time. When the tasks that come before it in the structural specification are complete, the workflow job may begin. However, if time limits are included, they must be met in addition to the other limitations if the assignment is to be completed effectively. There is an argument that may be made for adding time limits to the execution split.

However, we believe these restrictions are sophisticated enough to warrant their own phase of workflow modeling. Here, we catalog the many temporal restrictions that might be placed on process parameters. There may be moments in our processes when we need a job to be completed by a given time. There's flexibility in how you may define time limits. A deadline for a single job is independent of the timeliness of any other tasks in the process. The deadline for completion of Task 1 (T1) may be set explicitly. If the deadline for Task T1 was met while

it was still being executed, the workflow engine would perform the necessary steps at the time of execution. As a characteristic of the job, the time limit for the work might be set.

There are two possible approaches to setting a deadline for a single activity. The first kind of job is designated at the outset of the process with the due date. A deadline specification gives a model of the time necessary to complete the process, encompassing all previous tasks and the work at hand. The second kind represents the maximum time that may be spent carrying out the work and is set at the outset of the process. Deadlines for individual tasks might be either relative or absolute. We can set a firm deadline that is independent of the present time zone. If the task deadline is not altered in the workflow specification, then it will be the same for all instances of the process. Workflow constants, such as deadlines, are specified. The deadlines are given as a percentage of the current time. Due dates that are reliant on one another create temporal interdependence between activities.

An example of this would be requiring that job T2 be completed in a certain amount of time after task T1 has been started or completed. Between times T1 and T2, the workflow engine may need to complete a number of different activities. A temporal flow with a deadline constraint added graphically depicts the temporal dependence.

The wait constraint is a subtype of time constraints. We may want to wait for a certain amount of time at various points in the workflow's execution. Such a wait specification, like deadlines, may be task- or activity-dependent. For a given job, the wait time before it begins running may be set using a task-specific wait. This delay, like the deadline, might be set at the outset of the process or the job itself. The delay specified by the workflow's commencement time represents how long the workflow must wait before the execution of the job without wait may begin or be completed. The minimal time permitted for job completion is modeled by the wait time after task beginning. The job will wait till the wait time has elapsed before continuing.

Due to the interdependent wait, there is now a time constraint on both jobs. To illustrate, we may say that Task T2 can't begin or end until after Task T1 has begun or ended. Temporal flow, when a wait constraint is added to the flow, is used to symbolize temporal dependencies. Any number of instances may be processed by the mandatory constraints' workflows at once.

Consider the example of a university's admissions office, which must adhere to a strict requirement that all submitted applications be reviewed before a decision is made. Workflow applications are already difficult to implement without the addition of these and other time-related limitations.

The shortest, longest, and typical timeframes to complete a job are all significant time-related metrics. Reasoning the viability and efficacy of a workflow application necessitates such definition together with deadlines, waits, and compulsory limits. A conditional value iteration notion was introduced in structural specification. Temporal iteration is another kind of iteration that may be modeled to repeat a job for a certain amount of time. This idea is particularly helpful for modeling tasks in transactional workflows that include time-dependent redo features in case of errors. Timely workflow task completion may also be impacted by other factors such as workload, employee availability and efficiency, vacations, etc. It is crucial for processes with many performers and anticipated instances to identify temporal limitations and related bottlenecks during the modeling phase.



### **3.4 Potential of Low Code/No Code Application**

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LCN modular techniques facilitate the rapid development of applications by freeing expert developers of the necessity to create code line by line. In addition, they allow business analysts, office administrators, small company owners, and others who are not software professionals to construct and test applications. Users are able to create apps without prior knowledge of machine code, conventional programming languages, or the development effort underlying the platform's changeable components.

Users are constantly provided with an easy graphical user interface that simplifies the integration of third-party APIs and reusable building pieces (APIs). Periodically, programmers may restructure and test the program's components to ensure that it functions as intended.

LNC platforms have emerged in response to the dearth of qualified software engineers and the need to accelerate development project turnaround times.

### 3.4.1 Cloud based solution

Since the development, expansion, and improvement of the Internet have made some tasks possible to be carried out remotely, this is now the case. Customers should be able to use the technology they already have without having to shell out more cash for upgrades. The user accesses the Internet using his existing gear, submits a service request, and gets a response. This is obviously more costly, but for some customers, it is preferable than buying brand new equipment for a side company. Cloud computing is a model for delivering services in which users rent access to shared computing resources and infrastructure in order to complete a wide range of tasks, from simple ones like document production to complex ones like running a virtual machine. (Skendzic, A., & Kovacic, B. (2016, January 1). Microsoft Office 365 - cloud in business environment | Semantic Scholar.

<https://www.semanticscholar.org/paper/Microsoft-Office-365-cloud-in-business-environment-Skendzic-Kovacic/94080f95baeb08a9baa1df283091d6247880fbd1>)

What we now call "cloud computing" includes much of our everyday work. Cloud computing may be defined as a paradigm in computer science where services are made accessible online and used by clients in certain scenarios. To further confuse matters, "cloud computing" might be understood to include both the cloud and the services hosted there. The term "the cloud" refers to a network of remote servers on which various applications may be deployed and made accessible through the Internet. Three categories of cloud-based services are discussed today. (Web source: Mreža, <http://www.bug.hr/mreza/tekst/cloud/95395.aspx>):

- Software as a service, SaaS
- Platform as a service, PaaS
- Infrastructure as a service, IaaS

As described by the term "Software as a Service" users simply have to pay to get entry to and use the software that is hosted on a remote server. However, it is not apparent which SaaS models are cloud-based. The service provider rents the necessary computer infrastructure and then puts his own services on it.

Users may rent the underlying infrastructure based on the PaaS or IaaS model and make their own usage decisions. In the IaaS model, clients rent a cloud-based virtual machine, while platform users construct and distribute their own cloud-based apps. Cloud computing may also be segmented into private clouds, each of which has its own unique set of advantages and

disadvantages that must be carefully weighed. Aside from tech-related inquiries, we also get questions on a wide range of other topics. Adaptability, accessibility, and independent rule over all other things are all attributes ascribed to nature, compatibility, security. Before the advent of the cloud, it was left to individual computer users to choose the appropriate application, platform, and underlying infrastructure.

This mode of operation allows cloud providers to more profitably rent their infrastructure out, allocating resources to different customers in accordance with their specific requirements and priorities. It has been shown that there are several gray regions associated with cloud definition. The most difficult part is figuring out what constitutes a cloud; typically, this is done by looking at the scale of the underlying infrastructure. Use of, and efficiency with, existing infrastructure is crucial to the success of any enterprise. From the point of view of the user, it may seem as if resources may be drawn upon on demand. This is often done via the use of virtualization and efficient allocation of resources. Accessibility and security are the two biggest drawbacks. It is expected that users would rely on services hosted on third-party networks. Losses to capital are possible if infrastructure fails due to unforeseen circumstances. Additionally, services may include sensitive information that must be safeguarded while stored in the cloud.

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The cloud service provider must build trust with his customers by reassuring them that their data is safe in the cloud. Providers risk total financial collapse in the event of a security breach or data loss. This may also occur if the service is consistently unreliable or malfunctions. Customers won't choose a cloud service if the vendor can't provide consistent performance. The methodology used to evaluate the various cloud services is based on information gleaned from user feedback and reviews of commercial cloud services like Office 365.

There has been a demand for additional processing capabilities, better back-up storage, updates and improvements in infrastructure, and a reevaluation of business models as organizations continue to expand not only in number of personnel, but also in departments and branches. According to (Staten, 2008), in order to outsmart rivals and increase market share, firms must adapt new technologies to survive in the markets in which they participate. Many businesses nowadays are finding success by using the many services available in the cloud. Compared to the more conventional method of calculating, this newer method has

found widespread use. The majority of users benefit from these services as virtualized hardware and software.

In addition to being distinct from previous forms of computing, this kind of computing allows for user-interactive programs like web-based ones. Cloud computing is predicted to be simple for programmers (Weinhard et al., 2009). Because this technology implies content-based application building, developers may simply obtain application components like web services or third-party software libraries. Cloud computing has the potential to be a very useful resource for companies. To begin, instead of spending money to upgrade or improve the performance of local computers, businesses may use low-power processing systems to operate web-based services from the cloud.

### **3.4.2 Data based applications (no code /low code)**

Companies and organizations need powerful resources to adapt to ever-changing, complicated market situations and demands, made more so by advances in information technology and digitalization trends (Sanchis et al., 2020). McLean (2021) describes LNC development as a visual software development methodology in which programmers may drag-and-drop and link components to create mobile or web apps. Using a component-based strategy, even experienced programmers may quickly and easily build complex software systems (McLean, 2021). According to a report by Richardson and Rymer (2014) in Forrester Research titled "New Development Platforms Emerge For Customer-Facing Applications," low-code alternatives are preferred by businesses and organizations over time-consuming hand-coding because they allow for rapid, continuous, and test-and-learn development and delivery.

Richardson and Rymer (2016) discovered that the use of a minimal code development platform might enhance the pace at which corporations and other organizations build and deliver new mobile apps by a factor of 5 to 10. According to projections made by Gartner, a technology research and consulting firm, 65 percent of application development projects will employ Low-Code Development by 2024 (Duffy, 2019).

Thus, it is necessary for the general public to have a thorough grasp of LNCD when it is quickly adopted and valued by enterprises and organizations. Low/No-Code Development has not been widely adopted by businesses as an alternative to the standard way of software development while offering a wide range of benefits. This is due to a number of factors, including a lack of familiarity with Low/No-Code Development Platforms (LNCDP),

apprehension about becoming too reliant on a single LNCDP provider, doubts about LNCDP's ability to create the desired applications, and concerns about security, scalability, and lack of adaptability. (OutSystems, 2019) Warren from OutSystems (2018) supported LNCDP and showed that several of the complaints regarding it, such as its inflexibility, scalability, and security, could be dealt with. OutSystems, Microsoft, Salesforce, Mendix, and Appian were among the top LNCDP developers examined by Alsaadi et al. (2021).

We will examine the characteristics and capabilities of these platforms, with a focus on the data obtained from researching the Low/No-Code industry in its entirety. The study concludes by exploring contrasting viewpoints on the impact that LNC development will have on the future of software development and digital transformation. Though LNC Development has only been around for a short period of time, its quick uptake by businesses gives us reason for optimism. LNC Development will usher in a paradigm shift in the software development industry and pave the path for digital transformation, according to the conclusions of our research.

From the graph, it is clear that almost all of the companies polled were taking some kind of action toward digital transformation.



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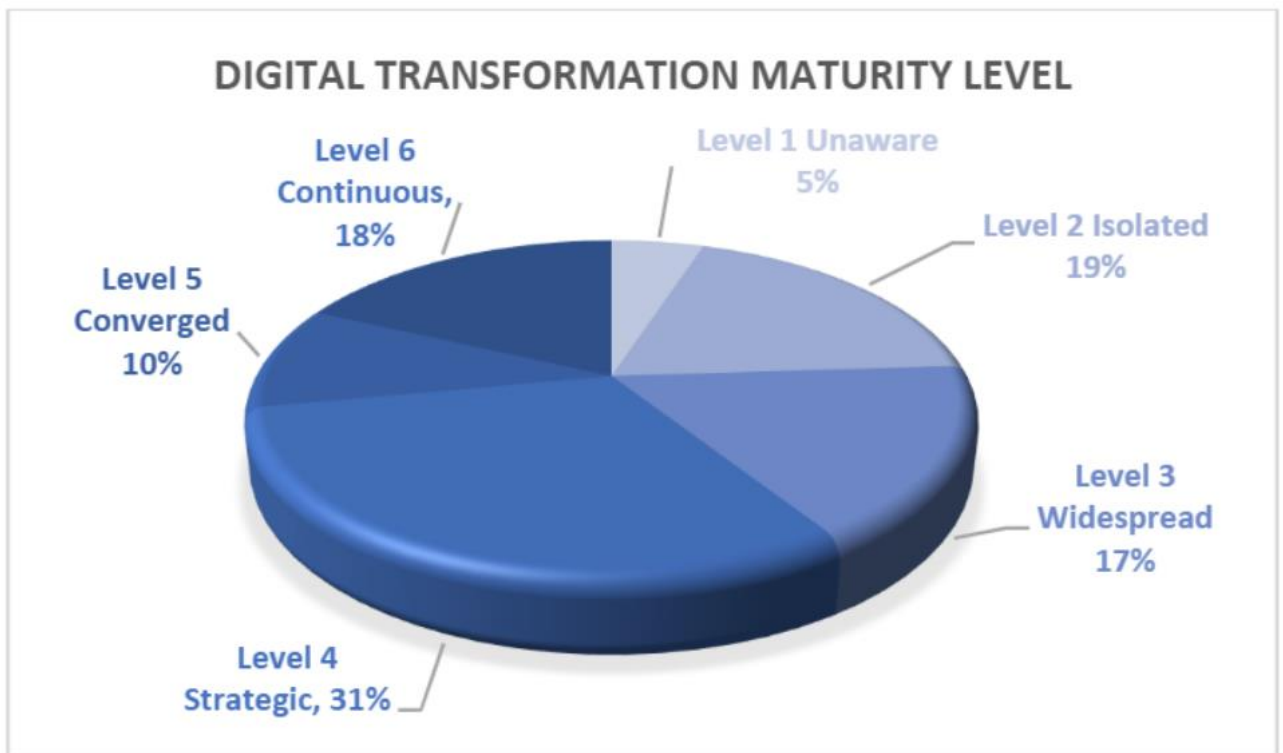


Figure 7 Digital Transformation Maturity Level. Data source: Outsystems (2019)

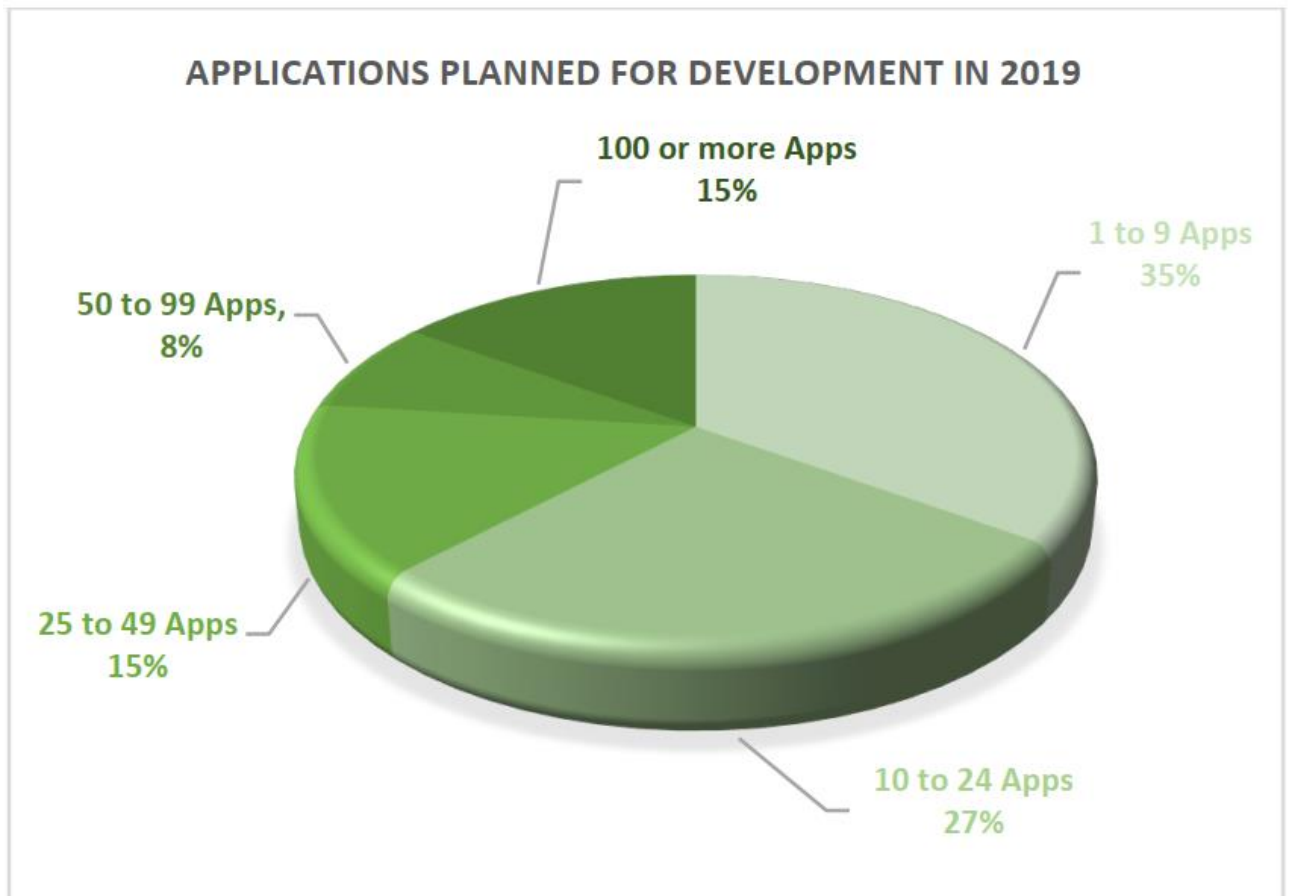


Figure 8 Apps that are slated for development. Data source: Outsystems (2019)



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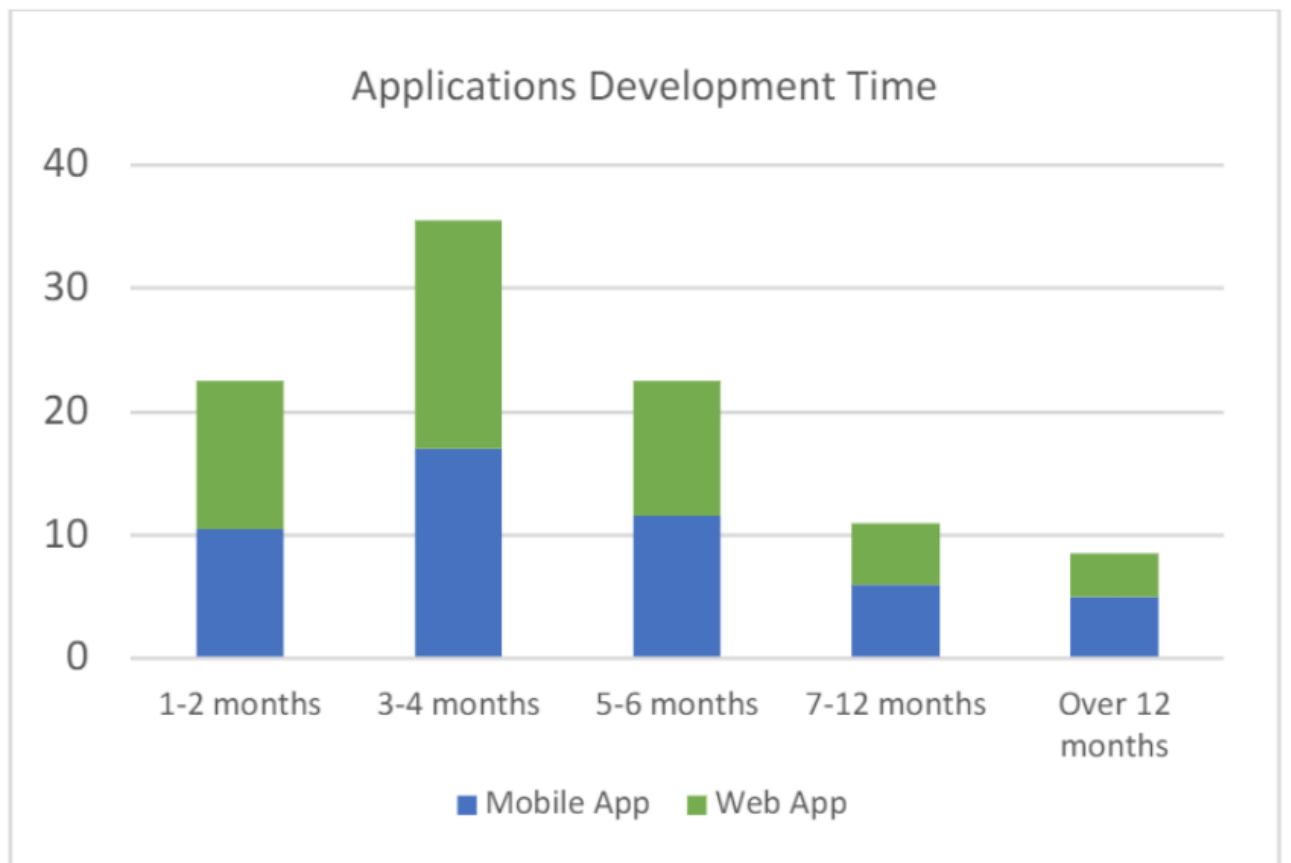




Figure 9 Timing for Application Development. Data source: Outsystems (2019)

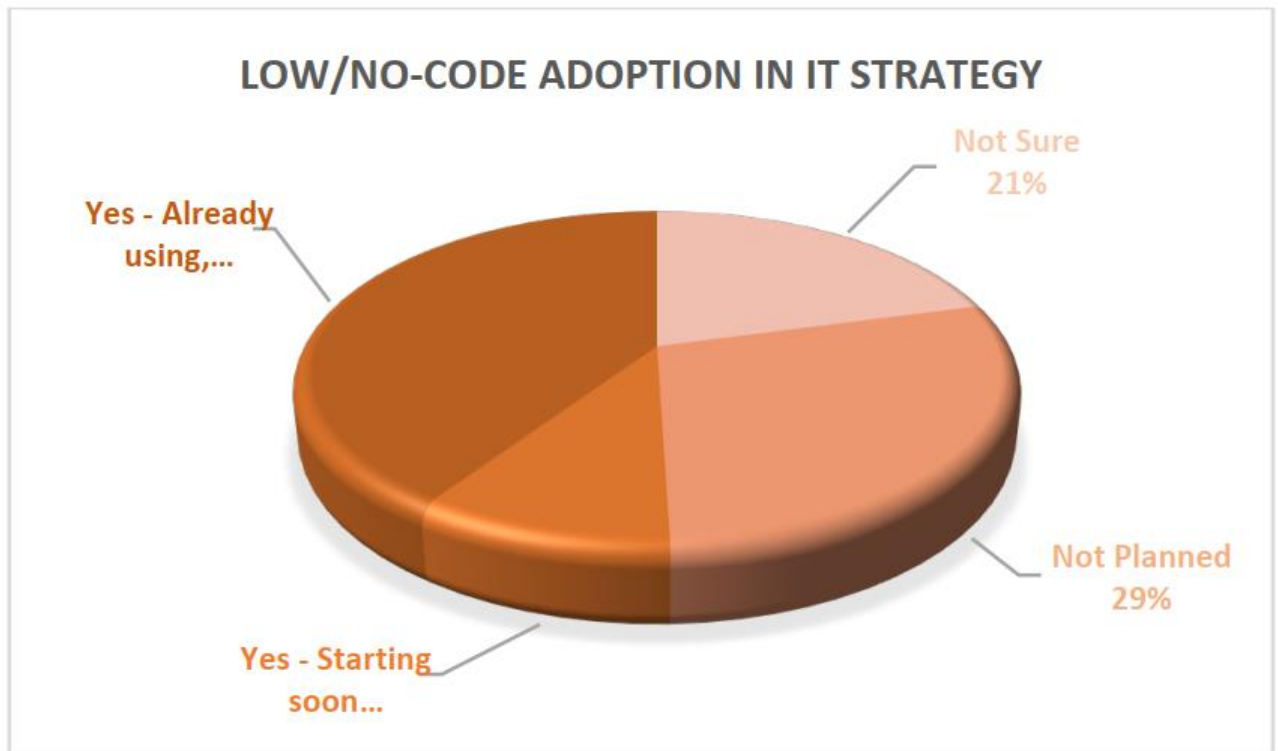


Figure 10 Use of Low/No-Code in IT Strategy. Data source: Outsystems (2019)

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Next, we'll discuss the characteristics of the investigated LCPs that we've categorized into three categories: frequent, occasional, and unusual. Where appropriate, we shall classify these characteristics as belonging to the static, functional, or dynamic viewpoint common to systems engineering. FIGURE 7 provides a concise overview.

The static viewpoint describes the majority of LCP characteristics. Each product that has been examined has a feature that allows for the specification of data structures. This feature is often provided as a conceptual modeling tool, which uses either a reduced version of a proprietary language or a derivative of a traditional data modeling language (such as the Entity-Relationship Model). Dialogs and lists may be used in the user interface to specify data structures. Access to external data sources may be obtained via a number of application programming interfaces, which is another characteristic shared by these systems (APIs).

### Features of low-code platforms diagram

At the beginning, we will display the identified characteristics of the analyzed LCPs based on

their frequency of occurrence, differentiating between regular, infrequent, and rare characteristics. The static, functional, and dynamic perspectives of systems development will be utilized to describe these characteristics. The summary is shown in Figure 11.

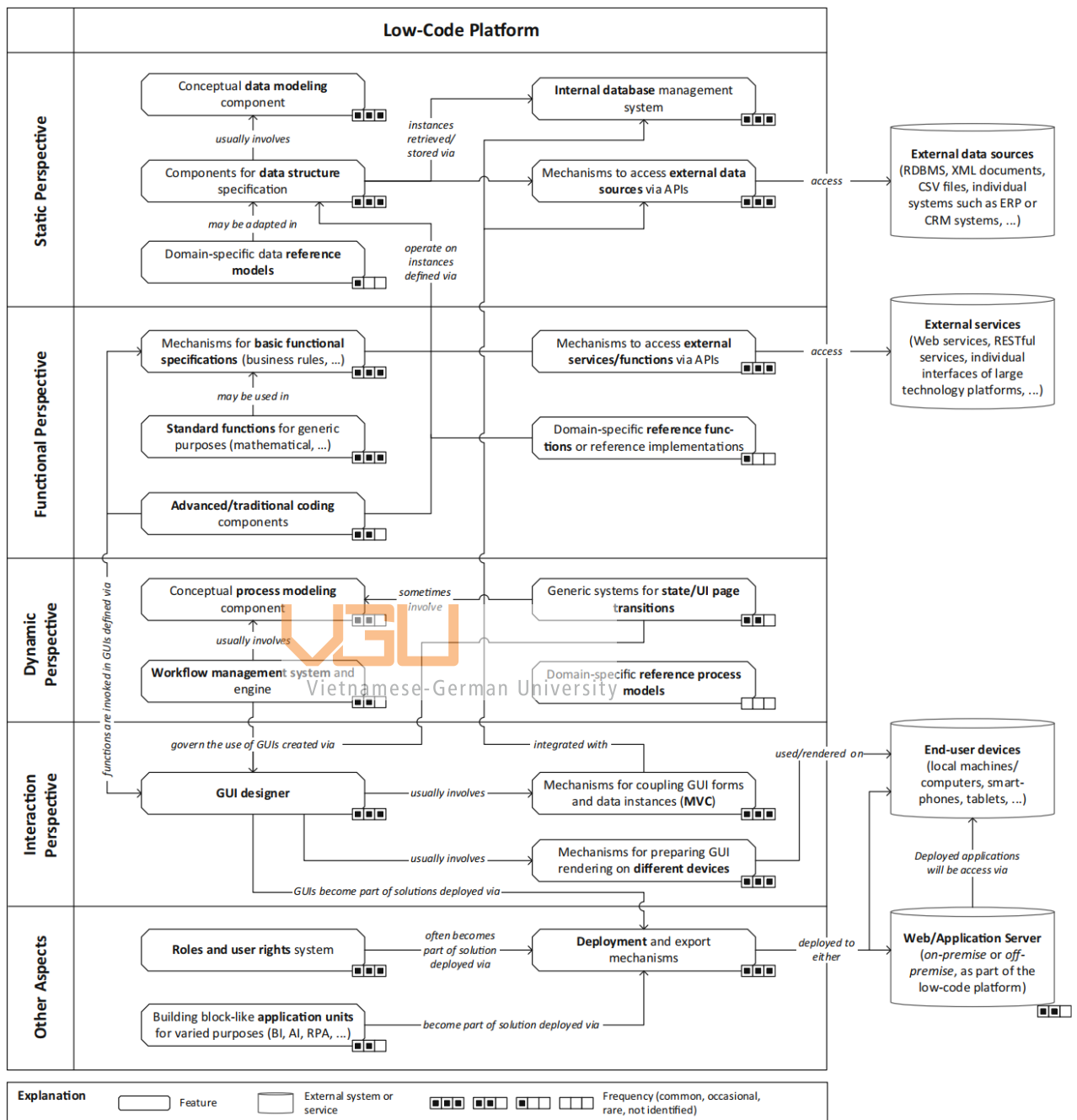


Figure 11 Features of low-code platforms

All platform solutions, for instance, provide common APIs like Java Database Connectivity (JDBC), in addition to a wide range of file and system connectors. Standardly, the platforms are built such that information may be kept in either a local database or in third-party services. The research also shows that every low-code platform has a graphical user interface (GUI) designer as another standard feature. All of the systems that were analyzed have some kind of

GUI development and integration tool built in. Even though their feature sets vary greatly, all of the assessed GUI designers include libraries of pre-defined widgets. In most settings, it is not essential to manually implement the model-view-controller (MVC) paradigm to define the connection of graphical user interfaces (GUIs) and data structures. What's more, the majority of solutions provide specialized aid for localizing user interfaces for various contexts (e.g., desktop browsers, tablets, and smartphones).

What's more, the minimum functional requirements of every system are always met. The most often used methods here are dialog-based condition specification languages and simple expression languages for expressing decision rules. Each option also includes a collection of commonplace general procedures like mathematical functions. All systems provide contact with external functions and application programming interfaces (APIs), although in varying ways. On most systems, Web services and RESTful services are accessible. Several systems also permit the usage of third-party APIs, including Google APIs and social network APIs.

Moving on to a new topic, practically all of the viable solutions offer high-level support for application deployment, although in vastly different ways. This was already noted. The environment of the LNC platform, for instance, may need to be installed on a web server before any particular apps may be deployed there. In contrast, some frameworks let the solutions to be deployed as standalone apps on a wide range of hardware. Almost all of the systems we looked at also included a feature that allowed us to specify who had access to what, making role definition another universal quality. The platform's governing architecture often includes the roles and user system, which will be implemented in tandem with the bespoke application. The dynamic viewpoint encompasses a wide range of uncommon characteristics.

Workflow modeling capabilities and a workflow engine are also sometimes seen. As stated above, a Workflow management system (WFMS) sits at the core of the architecture of some of the bigger and more complicated LCPs, while other systems are marketed as LCPs but are, in fact, standard WfMS. Platforms could use a conceptual modeling language such as Business Process Model and Notation (BPMN) or a custom representational structure. In some other systems, the point of view is more generalized and technical. These systems primarily provide widgets for defining how users move between and interact with different UI forms they've created. While some platforms use a custom-built process modeling feature, others fall back on tried-and-true methods like pull-down menus and event-tracking code. Access to both modern and classic code constructs is also a rare but welcome feature.

In the case of some systems, procedural specifications may be produced with the help of common programming languages and associated tools for a single or several explicit components. Java and JavaScript are often used in these systems. In fact, practically all low-code systems provide access to conventional programming code, although at a buried architectural level. Lastly, the main vendor platforms we looked at provide a wide range of modular, flexible applications. These departments may provide pre-built features in a certain field, such as business intelligence (BI), artificial intelligence (AI), or robotic process automation (RPA). Only seldom were relics of reference implementation that were peculiar to a certain domain found to exist.

Few domain-specific reference data models include pervasive business and communication terms such as "customer," "address," and "email," but a huge platform does. Most examined LCPs do not carry any data reference models with them, whereas some other systems give tiny collections of basic reference structures. And even fewer artifacts are determined to be domain-specific reference functions and dynamically reusable artifacts. Numerous pre-built features from different business apps from the same vendor may be shared within a single, comprehensive platform. Most of the other systems that have been investigated include a library of reusable functions or instances of established processes; however, they are either highly general in nature or very shallow.

### **3.4.3 Specific applications for SME**


In this section, we will explore an example is Power Platform is the low-code / no-code to implement to SME departments. As a business applications platform, Microsoft's Power Platform combines its low code/no code features. Anybody, from corporate users to expert developers, may create applications, combining the abilities of those who need the applications with those who create and manage them.

Power Platform has become an essential tool in many enterprises, not only for the development of bespoke interfaces for line-of-business applications, but also for the automation of robotic processes. Furthermore, with the incorporation of Power Automate's desktop software into Windows 11, flows will become an integral part of everyone's computing routine.

Recently, the Power Platform has taken on a new role as a platform for fast application creation, bringing together cross-organizational teams to design and manage apps that address unforeseen gaps in service capabilities — notably during the COVID-19 epidemic. This strategy has enabled the United Kingdom's health services to swiftly create and deploy vaccination booking systems, utilizing the Power Platform as the adhesive to connect disparate systems and wrap them in a new set of business processes.

### 3.4.4 Benefits of Power Platform

The Microsoft Power Platform is an integrated set of tools for gathering and analyzing data, creating and connecting apps, and analyzing business trends. They aim to optimize routine business processes and operations by analyzing data, customizing dashboards, building tailored apps, reacting to created insights, and automating activities with less reliance on core technical skills. (Adel, L. (2021, September 6). Top 10 Benefits of Microsoft Power Platform - pmo365 | Project Portfolio Management Solution. Pmo365 | Project Portfolio Management Solution. <https://pmo365.com/top-10-benefits-of-microsoft-power-platform/>) The suite's four main features are as follows:

- 
- **Power BI** is an enterprise analytics solution that helps businesses analyze their data, find previously unknown insights, create engaging data visualizations, and integrate previously siloed data sets.
  - **Power Automate (Flow)** is a service that aims to increase productivity by means of the simplification, automation, and improvement of business processes and workflows via the application of artificial intelligence.
  - **PowerApps** is a service that provides a library of pre-built tools, as well as access to additional applications, services, data connections, and platforms, to facilitate rapid app prototyping and deployment without the need for extensive coding knowledge.
  - **Power Virtual Agents** is a service that makes it simple to create and maintain advanced chatbots that can interact with consumers and workers alike and take appropriate action based on the data they gather.

### Ten Major Advantages of Microsoft's Power Platform for Your Business:

1. Organizes your professional tasks in one place

To avoid functional silos and bottlenecks in the modern digital workplace, it is essential to

ensure that all data is up-to-date and easily available. Thanks to Microsoft Power Platform's comprehensive features, you can easily manage data throughout your company by connecting Office 365 to external data stores. You may see the whole scope of your project portfolio at once.

## 2. Increases the reliability and utility of the data

The custom applications generated by Microsoft PowerApps allow businesses to design forms with fields tailored to their unique requirements. Power Automate helps us guarantee that information is sent without interruption from any external data source or application. Nonetheless, data collection and access are only the beginning. The true value of data lies in gleaming useful insights from it and then acting on those findings. Power BI automates the creation of these vital visualizations, ensuring that businesses seize all available possibilities.

## 3. Streamlining procedures and raising total output are three major benefits.

Microsoft Power Platform eliminates the need for time-consuming, error-prone manual updates, routine chores, and paper-based procedures. With Power Automate, your team can save time on mundane chores by digitizing and automating them, freeing them up to concentrate on the parts of projects that provide the most value.

## 4. Reduce expenses significantly

Forrester found that using PowerApps and Power Automate cut down on time and money needed to build an app by 70%. The 2019 research finds that businesses may save over 50 percent on licensing costs by not renewing ancillary service subscriptions, such as vendor application subscriptions, due to the flexibility of PowerApps. The cost savings from using Microsoft Power Platform are substantial when you consider the whole scope of your project portfolio and factor in the time and effort saved by using the platform's straightforward features and data.

## 5. Management of compliance is simplified

Since more and more businesses are realizing the need of doing their part for the environment and society, the pressure to promote responsibility and compliance has only intensified. However, it is not always easy to maintain a state of readiness and make sure all procedures are covered. Power Automate and PowerApps provide businesses complete command over

the data collecting procedure and its subsequent analysis, allowing them to ensure that all necessary steps are taken. This simplifies compliance demonstration and permits easy adjustments in the event that compliance norms change.

#### 6. Simplifies report-keeping

We can probably all agree that reporting is the most dreaded part of our jobs. It is possible that the time and energy spent on it may have been better spent elsewhere. According to studies, yearly report compilation takes project managers at least one day of work. Power BI makes it possible to quickly and easily create reports, visualizations, and dashboards. Furthermore, after all operations are consolidated into the Microsoft platform, reports may be filtered to take into account certain input fields or requirements as required by your group.

#### 7. Allows for multi-device support and remote access to work

The year 2020 has shown our proficiency in digital work and the significance of digital technology integration in future operations. When it comes to online and mobile app connectivity, many older systems just aren't flexible enough. Through the Microsoft Power Platform, you'll have constant access to cloud-based systems, desktop applications, and more for communicating with your distributed team. Easy access to your project's happenings across any and all devices is guaranteed.

#### 8. Strengthens the safety of your data

Microsoft Power Platform's integrated features allow you to store all of your data in a single, dependable location. The Microsoft 365 suite of products is developed in the Infosec Registered Assessors Program (IRAP)-approved Microsoft Azure data centers. The Information Security Certified Assessors Program ensures that the data, networks, and systems of Australian government organizations are protected to the highest attainable quality.

#### 9. Ease of use and feature optimization are facilitated in version

It used to take a lot of time and money to train IT experts and hire new employees to help with the development of corporate business applications. As a result, only a select few were able to take use of the full potential of PPM systems. The Microsoft Power Platform's strategy of low- to no-code considerably improves its adoption and use. Citizen developers may often improve their service without much assistance from IT by generating fresh insights and

designing speedier procedures, for instance.

#### 10. Benefits from the impending wave of AI technology

Artificial intelligence (AI) methods such as neural networks and machine learning are anticipated to have far-reaching implications in many sectors, but especially in project management. Use Microsoft's Power Platform, which includes tools for predictive analysis (Power BI and Power Virtual Assistant) and the robotic precision of PowerAutomate to automate repetitive tasks with smartbots, to take advantage of AI in all its manifestations.

#### 3.4.5 Implementation the solution in the business

This requires examining the process flow throughout the whole organization yet creating and testing the solution for each business process in a logical progression of iterations. Every company process is implemented using Lean business process improvement strategies (Lean business models enhance value stream operations by eliminating waste and maximizing customer value).

#### Modernized Workflows



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In many cases, corporate users took on initiatives that simplified and computerized previously manual tasks.

By automating these traditionally manual tasks associated with older applications, robotic process automation proved extremely effective here. In addition, the time spent on human interactions like emailing back and forth to get information was considerably decreased thanks to virtual agents. Time savings are estimated, and these time savings provide the basis for many of the positive business outcomes mentioned further on in this research.

**Facts and figures.** Examples of time-saving Power Platform initiatives developed by corporate customers were provided by those interviewed.

- "A vice president is the intended audience for a custom robotic process automation system" (VPs). Data is centralized on a dashboard, eliminating the need to scour the internet for answers. Four or five hours a week are being freed up for two hundred vice presidents.
- Commissioning a new building resulted in a 25% reduction in the time required to complete the process.
- Schedule development time for production teams was cut by 75%.



- By improving project estimates, equipping workers with inventory pick lists, and monitoring their time, a company was able to cut the number of hours spent on client projects by 10%.
- "The most useful feature is that users may generate their own reports," the developers said. It reduces the time needed to create anything from a few months to something that can be done on the go.
- A business-developed Robotic process automation (RPA) effort enabled a decrease in the size of the go-to-market team from twenty to ten employees.

**The use of models and presumptions.** On the basis of these illustrations, Forrester established the following assumptions for his financial analysis:

- As more projects are completed using Power Platform, a greater number of people throughout the whole business will reap the benefits.
- As solutions evolve to maximize process efficiency and boost automation, the efficiency benefit grows. The integration of the four Power Platform subsystems into more comprehensive answers is a major factor in this regard.
- We use a productivity capture of 50% since not every time saved results in increased work being done.



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**Risks.** This advantage may be understated if, for example:

- Fewer business user initiatives that benefit their colleagues are initiated.
- Investing in methods that don't standardize and automate company operations.
- Less money spent on salaries and benefits for workers.

Forrester reduced this benefit by 20% to account for these dangers, resulting in a total PV of \$10.2 million over the course of three years.

“We built a virtual agent for onboarding hires. It is saving 300 people a lot of time when looking for information. The operations community was ecstatic when we rolled it out to them.” Manager, petrochemical

### 3.4.6 Results

Most businesses are aware of the impending seismic upheaval in how they carry out activities and keep operations running as a result of the paradigm shift in automation technologies. The

new era has here, and with Microsoft Power Platform, corporate users may take advantage of individualized processes and data analysis. (Sanchis, R., García-Perales, S., Fraile, F., & Poler, R. (2019, December 18). Low-Code as Enabler of Digital Transformation in Manufacturing Industry. MDPI. <https://www.mdpi.com/2076-3417/10/1/12>)

Products built on Microsoft's Power Platform, for instance, may be used as a unified model to provide companies with streamlined reporting and operation. With Microsoft Power Platform, today's organizations have the tools they need to adapt quickly to and overcome market problems.

With Microsoft's Power Platform, companies may increase their agility, sales, and other business results without having to invest much in custom app development. Power Platform also facilitates seamless integration with other intelligence tools and third-party apps, making it ideal for usage by corporate users.

### **Advantages of the Power Platform, Presented in Numerical Form**

**Compared to standard software development approaches, LNC projects generated by regular people are less expensive.**

Projects of all shapes and sizes may be completed with the Microsoft Power Platform. The research found that after introducing Power Platform, the number of medium-sized projects decreased by half. As a result of the implementation, time spent on major projects decreased by a staggering 70%. Overall Economic Impact projects a net savings of \$2.0 million, or 48%, after accounting for potential risks.

**The Power Platform has been implemented in lieu of legacy systems and external business apps and BI tools.**

According to Forrester's analysis of the interviews, suppliers may have been able to meet some of the demands that business customers met with their own solutions. Licenses for competing BI tools are nullified by the use of Power BI. Study estimates total risk-adjusted savings over three years of around \$829,000.

**Users were able to do more with less effort because to Power Platform solutions.**

For the study's compound organizations, 50 users profit from each medium-sized project, while 300 users gain from each large-sized initiative. A research conducted over the course of

three years found that Power Platform use increased efficiency from 3% in year one to 5% in year three.

### **Effectiveness of Power Platform Boosted Organizational Results**

Results from the Total Economic Impact analysis showed that Power Platform efforts improved sales by 1% over the course of three years and raised operating margins from 12% to 12.5% thanks to lower operating expenses.

### **The Power Platform's Incalculable Advantages**

#### **Workers' decision-making processes have sped up.**

Workflows and apps developed using the Power Platform aid in the efficient collection and dissemination of data. In addition, Power BI facilitates the development of business-enhancing insights inside businesses.

#### **Enhanced data protection using the Power Platform**

Since the Power Platform is part of Microsoft's security stack, it's much simpler to implement the essential safeguards across all development projects. The Total Economic Impact analysis found that companies who utilize Microsoft Teams as their primary collaboration solution reaped the most benefits from adopting the entire Power Platform.

#### **Integration with other Microsoft products for maximum benefit**

Research participants claimed they reaped advantages from utilizing Power Platform to optimize and grow their use of other Microsoft solutions by increasing those solutions' capabilities and integrating them more thoroughly.

#### **Inventions that do away with the need for conventional development**

No of whatever low-code or no-code platform components the company interviewed chose, the Power Platform always resulted in savings on project time and money.

# Chapter 4 - Architecture blueprint to address LCNC for SMEs

## 4.1 Choosing low-code/no-code software

This includes the 2018 Enterprise Engineering Working Conference Forum session summary report (EEWC 2018). By iteratively developing the enterprise design methodology's meta-model and applying it to real-world situations, low-code development platforms may speed up and strengthen digital transformation, according to the research. (Jepma, W. (2021, September 28). Key Learnings from Gartner's Magic Quadrant for Enterprise Low-Code Application Platforms in 2021. Leading Business Process Management (BPM) applications, tools, vendors, and Business Process Management Suites (BPMSs).

RESTsec is a low-code REST platform that was proposed by Zolotas and co-workers in. It enables the rapid modeling of security requirements for business services in compliance with the latest attribute-based access control (ABAC) authorization scheme. Authors claim that using RESTsec, developers can easily include the appropriate access control policy and rapidly and automatically construct the service, the security architecture, and the code. A second series of low-code studies investigates the domain-specific languages (DSLs) used in the development environment supplied by OutSystems Platform, which is headquartered in Boston, Massachusetts, United States. The authors of this research examine these obstacles in light of the fact that process modeling, also known as business process technology (BPT), has a low acceptance rate and is often believed to have usability issues. Therefore, they work on a new version of BPT and test it thoroughly to make it easier for programmers to use.

The Virtual Library of Romanian Literature will benefit from an integrated software platform (INTELLIT) created by the Institute of History and Literary Theory "G. Călinescu" of the Romanian Academy, the "Lucian Blaga" University of Sibiu, the National Institute for Research and Development in Informatics, and the Polytechnic University of Bucharest (2018). This essay emphasizes the low-code paradigm as a crucial factor in selecting the best technologies and concepts.

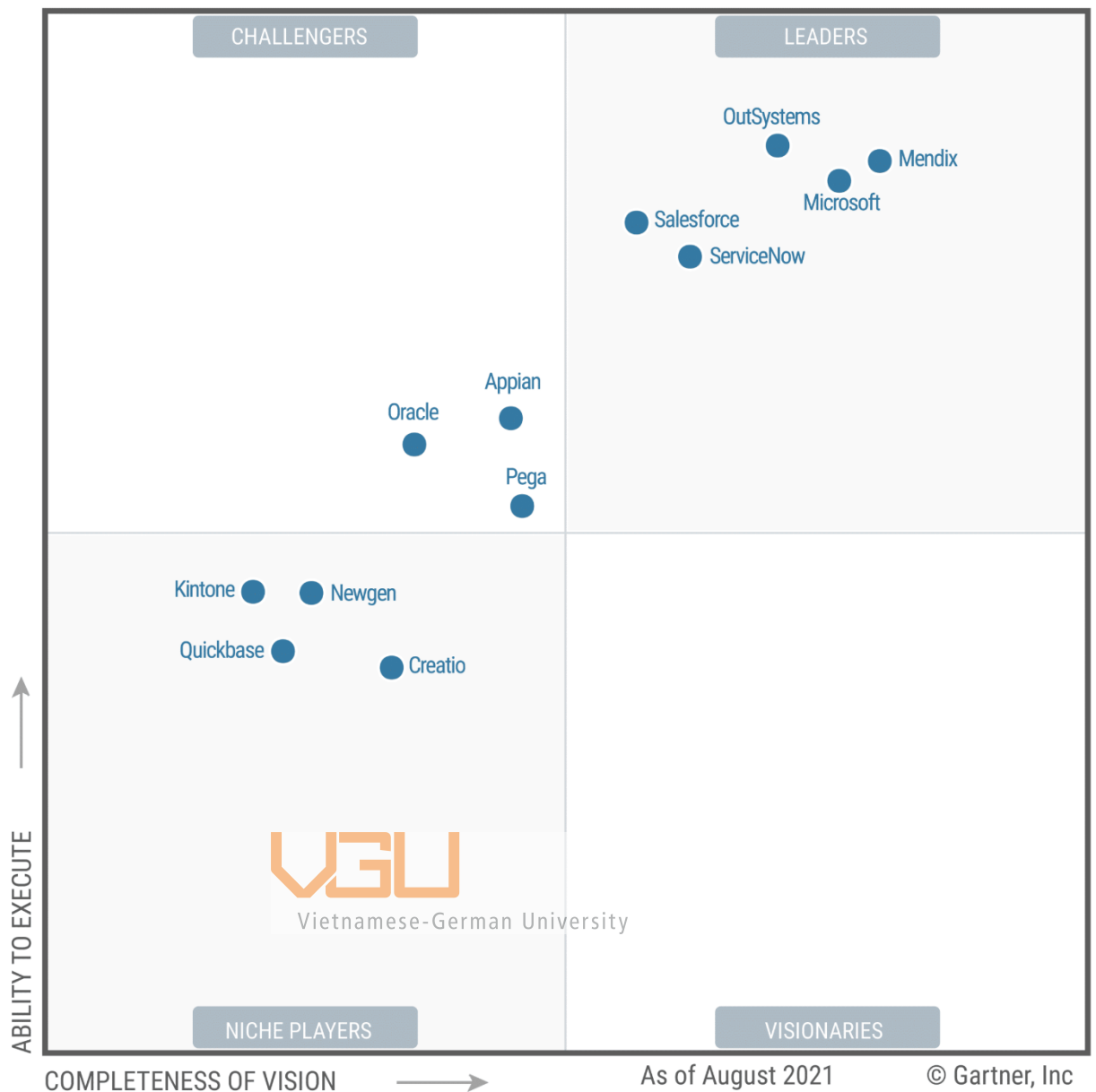
In the creation of the INTELLIT Platform, which is discussed on page 7 of Appl. Sci. 2020, issue 10. However, the study's emphasis is on something very different from what we're looking for in this one. The Lowcomote project is presented by Tisi et al., which is an ITN that aims to educate professionals in the areas of low-code platform design, development, and

management. This program intends to develop a heterogeneous, open, scalable, and scalable platform to tackle low-code platforms' disadvantages (supporting with models coming from diverse engineering areas). Panteleimon and co.

NETIoT is an Internet of Things platform that focuses on the applications enabled by a user's IoT device collection. The platform is constructed on hpaPaaS principles. This research aims to develop a low-code solution that does not need hardware changes and requires little configuration on the NETIoT platform in order for heterogeneous Internet of Things hardware devices to successfully send measurements to the platform. In a similar vein, Waszkowski discusses how the Aure Business process management (BPM) BPM low-code platform is used to automate industrial business processes.

The emphasis of Wu et al.'s research is on Q&A sites for programmers like Stack Overflow. Users may use this forum to seek advice and provide solutions on a broad range of programming-related concerns. There are hundreds of thousands of lines of code available for developers to utilize. Among the goals of this research is to pinpoint the roadblocks that have been placed in the path of greater code reusability. The results of exploratory study and a survey conducted by the authors indicate that there are three key barriers to reusing code from Stack Overflow. The following are these obstacles: (i) Too much code modification is required to accommodate their projects; (ii) the code is unintelligible; and (iii) the code quality is poor. The third barrier requires expanded Q&A platforms to improve or analyze source code fragments, highlighting the significance of low-current code.

Check out the Enterprise LCAP Magic Quadrant for 2021:



Source: Gartner (August 2021)

Figure 12 Low-Code Application Platforms in New Magic Quadrant

Among the many businesses low-code application platform vendors, Gartner has revised its Magic Quadrant to include a total of 12. The report's authors weighed the pros and cons of each service provider included and plotted their findings on the report's characteristic "Magic Quadrant" graph, which shows how well each vendor can carry out its stated mission. The figure divides the market into four categories: leaders, challengers, niche players, and visionaries.

The 2021 version of the Magic Quadrant for Enterprise Low-Code Application Platforms

differs visually from the 2020 edition because Gartner modifies the criteria it uses to assess providers to account for shifting industry trends. By way of illustration, Gartner revised its 2021 report's business and go-to-market inclusion criteria in response to shifting buyer priorities and market conditions. Because of this, the following applications did not make the cut for inclusion in this year's report: AgilePoint, AuraQuantic, Betty Blocks, Oracle (Visual Builder), ProntoForms, TrackVia, and Zoho.

The businesses that come under each category are displayed below, along with a list of all the categories.

### **Leaders**

Mendix is positioned at the top of the Magic Quadrant's Leaders section. With the introduction of cloud-native services, Mendix now enables multi-experience development projects and fusion teams. These extra services are provided by Mendix's LCAP solution. The study, from both Gartner Peer Insights and end users' viewpoints, is favorable towards Mendix's user experience design, integration assistance, and governance tools.

Microsoft's LCAP solution, Microsoft Power Apps, is second only to Mendix. It provides access to Dataverse and Power Automate, two components of Microsoft's Power Platform. Microsoft's user base is one of the biggest of any LCAP, and it spans a broad variety of businesses and sectors throughout the globe. Gartner believes the firm has the potential to make an impact in the LCAP industry due to its comprehensive market understanding, responsive positioning, synergistic products, overall viability, and AI-driven development approach.

OutSystems' ability to aid developers in increasing efficiency while creating cutting-edge corporate applications is a major factor in why it is regarded as a market leader. It helps businesses save time on app creation by providing services like advanced security, AI-enhanced development, and multi-experience creation. Gartner emphasizes the OutSystems Platform's excellent low-code capabilities, such as its UI design framework and artificial intelligence (AI) features, as well as its unique continuous integration and continuous delivery (CI/CD) and agile corporate planning.

The App Engine and Creator Workflows included in the Now Platform are ServiceNow's LCAP offering. During the last year, ServiceNow has enjoyed tremendous growth, allowing the company to increase its LCAP offering's investment and its client base's size. Gartner

highlights many of its strengths, including its dedication to product innovation (as seen by the company's incorporation of IoT and process efficiencies, as well as its response to market trends).

All 12 of Salesforce's industry cloud solutions take use of LCAP's extensibility features. As one of the biggest SaaS platforms in the world, it gives its LCAP features access to a sizable user base and thriving market. Gartner also highlights Salesforce's market response, citing the company's frequent product upgrades throughout the year, and its platform ecosystem, a helpful tool for businesses considering the adoption of Salesforce's LCAP solution.

### **Challengers**

With previous year's research classifying it as a Leader, this year's Magic Quadrant places Appian in the Challenger position. When it comes to complicated case management and business processes, Gartner believes the Appian Platform stands out because to its full-stack low-code automation capabilities. The Appian App Market, which gives users access to a wide variety of partner connectors and apps, is another asset. In addition, the Appian platform delivers sophisticated business process management (BPM) capabilities, automated security auditing methods, and standard business logic..



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Pega has advanced to the Challenger phase from the Visionary phase. The LCAP solution is only one of several provided via Pega's Infinity platform, which also provides a multi-experience development platform (MXDP), robotic process automation (RPA), and a customer relationship management (CRM) toolset. Low-code development for workflow and process automation, user experience design, and a product offering supported by a scalable, cloud-native, multitenant, microservices-based architecture are the company's core differentiators.

Oracle's Application Express (APEX) solution, which is part of the Oracle Database suite, is the last piece of the Challenger category. Despite fewer regular upgrades, Oracle's LCAP solution is robust and globally accessible for organizations with substantial ties to the Oracle ecosystem. Gartner highlights Oracle's freemium model, vibrant user community, and industry-leading database capabilities as reasons why APEX developers should choose the platform.

### **Niche Players**



In its narrow market, Creatio continues to flourish. Their LCAP solution, Studio Creatio, has benefited from Creatio's commercial expertise, aggressive strategy that prioritizes client requirements, and promotion of low-code development. In the last year, attendance and exposure have improved for the business's Accelerate event series. The advantages of aligning business and IT strategies, industry-specific use case support, and vertical market development are highlighted by Gartner.

Newgen is another well-known competitor who has returned to the Niche Player category. Newgen ONE Digital Transformation Platform, an LCAP solution, is distinguished by its great potential for automating complex processes at scale. Nevertheless, Newgen has been able to retain and even enhance customer satisfaction due to the platform's robust automation platform and flexible licensing options, despite the platform's ecosystem not being as established as that of other listed providers. Newgen's artificial intelligence-enabled capabilities include document processing, intelligent data collection, value-based pricing, and end-user training.

Quickbase distinguishes itself from the competition because to its no-code approach, which has helped both fusion teams and citizen developers discover more efficient ways to tackle operational bottlenecks. Quickbase offers one of the top customer satisfaction ratings on the LCAP market because to its upfront pricing, dependable deployment methodologies, and superior post-purchase support.

Kintone stands out among Niche Players due to the fact that it is a full-featured LCAP solution that employs a no-code approach and offers a variety of collaboration options. Owing to the limited scope of its activities, the firm is unable to compete globally with other suppliers. Kintone's comprehensive customer service continues to get a great deal of praise. As a consequence of acquiring new customers and money from licensing agreements, the company has been able to expand its ecosystem and strengthen its position as an LCAP supplier.

## **4.2 Architecture compound**

Because diversity of industry so that prove the theory, this study will explore Retail Industry.

Customer Experience	Marketing	Store Operations	Merchandising	Fulfillment
Manage Omni-Channel Services	Develop / Manage Promotions and Campaigns	Plan & Manage Workforce	Manage Product Development Lifecycle	Global Supply Chain
Manage Social Media	Track / Respond to Shopper Insight	Manage Store Inventory	Perform Customer & Market Analysis	Manage Inventory/ Distribution
Operate Customer Call Center	Develop / Execute Customer Loyalty Programs	Manage Store Performance	Category and Basket Analysis	Supplier Collaboration
Provide Customer Self-Service	Manage Product Marketing Content	Operational Compliance	Develop / Manage Plans for Products, Sales, and Pricing	Manage Transportation and Logistics
Maintain Customer Master Data		HQ Collaboration	Source Management	Pick, Pack, and Ship
Measure and Evaluate Customer Satisfaction			Supplier Collaboration	Digital Product Delivery

Figure 13 For example: Retail Industry Capabilities

Capabilities of this as below:



#### 4.2.1 Customer Experience Vietnamese-German University

Any time a customer interacts with a company, whether directly or indirectly, they are having an experience. Throughout the purchasing, using, and service phases, customers often initiate direct contact. In the world of indirect contact, it is common for contacts with a company's products, services, or brands to be imprecise. These interactions may take the shape of word-of-mouth recommendations or complaints, commercials, news items, or reviews, among others. (Schwager & Meyer. (2007, February 1). Understanding Customer Experience)

- Omnichannel customer service is when a business provides omnichannel customer service, they assist customers in a consistent way across several contact methods. With the help of multichannel customer care, organizations may help customers in a variety of ways.
- A well-managed social media presence for your company is the key to effectively interacting with your target audience. Mastering the most efficient strategies for maintaining a company's social media accounts may simplify customer acquisition and the development of a cherished brand. Successfully managing a social media presence requires preparation, research, and insight into the organization and its target audience, in addition to the ongoing

development of engaging content.

- Call center management: managers of a contact center are accountable for the daily operations of the firm, including the development, implementation, and monitoring of systems that support interactions between agents and callers.
- Self-service indicates that consumers must execute an activity or job on their own, without help from firm personnel. Consider a petrol station unless you are in New Jersey. Self-service gas pumps are available at the majority of U.S. gas stations.
- Customer data is a company's most valuable asset, if not its most valuable asset. According to McKinsey & Co., firms that use insights from high-quality customer data beat their competitors by 85 percent in terms of sales growth and more than 25 percent in terms of gross profit. Customer data influences upsell strategy, targeted marketing, and outstanding customer service, among other things. In addition, it is a crucial aspect of massive digital changes.
- Customer satisfaction: the stated level of customer satisfaction is often used as a metric to determine whether or not a company has met or exceeded consumer expectations. Customer satisfaction is a measurement of how effectively organizations please their clients. It's likely that concentrating on the customer's journey may provide insight on what motivates satisfaction.



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#### **4.2.2 Marketing**

This includes all of a company's attempts to promote interest in, and eventually sales of, its products and services. Marketing includes elements such as advertising, sales, and distribution. Some advertising for a company is conducted via affiliates. (TWIN, DRURY, & COURAGE. (2022, July 13). Marketing in Business: Strategies and Types Explained.)

- Marketing campaigns are well-planned, coordinated efforts to accomplish a specific corporate goal, such as raising interest in a new product or asking customer feedback. Email, print advertisements, TV/radio commercials, pay-per-click ads, and social media are examples of common media utilized in these campaigns.
- Track / Respond to shopper insight: Monitor customer feedback by inquiring, "Why?" and "What's next?" in order to get broader business insights that may guide more educated company choices.
- Develop / Execute customer loyalty program: Customers that often interact with a business should be rewarded with a customer loyalty program that you can establish and manage. It is a strategy for retaining prior customers and preventing them from shopping elsewhere in the future. When a customer spends more money or shows a

greater interest in the brand, they are rewarded more often.

- **Manage Product Marketing Content:** Marketing a product includes its development, testing, introduction, and sale to customers. To improve sales and demand, firms must engage in successful product marketing, which includes identifying the product's target consumer and effectively interacting with them.

### 4.2.3 Store operations

Retail operations are, in a nutshell, all that goes into ensuring a store, whether physical or virtual, functions properly for consumers. (Cvetkovic. (2022, March 7). How to Track Store Performance: A Retailer's Guide. Store Performance Tracking for Retailers (2022))

Retail operations include:

- Supply chain management
  - Cash operations
  - Store layout (both online and physical locations)
  - Customer service
  - Order fulfillment
  - Physical inventory
  - Master data management
  - Promotions and pricing
- 
- **Plan and Manage work force:** Workforce planning is when a company looks at its current staff to figure out what steps need to be taken to meet expected staffing needs.
  - **Manage store Inventory:** Store Management Despite the significance of inventory management to a company's financial line, many small merchants are inefficient with their stock. Several businesses fall short of customer requests due to inadequate inventory. In many circumstances, this will result in temporary or permanent customer exodus.
  - **Manage store performance:** Comparable to a physical checkup, assessing shop performance gives vital indicators that provide a clear picture of your organization's health. Yuvi Alpert, Founder, Creative Director, and CEO of the jewelry brand Noémie, says, "It evaluates performance over a broad range using a dashboard approach." This strategy takes a broader perspective than isolated measures, which concentrate on a single store or portion of a chain.
  - **Operational Compliance:** Despite the fact that CEOs are expected to "own the risk," as best practices have taught us for years, it may be challenging for compliance officers to create a fruitful working relationship with executives engaged in the operations of the

firm.

We, as compliance officers, are often focused with more basic problems, such as internal hotlines, policy administration, and the automation of due diligence, and hence we do not frequently address these topics.

The responsibilities you stated are essential to a successful compliance program, but more must be done to assure compliance across the whole organization. To accomplish this ultimate objective, both sides must collaborate.

- **HQ Collaboration:** Companies have struggled for years to remove silos and enhance interdepartmental collaboration, and this issue is only expanding. In an age when the market expects ongoing innovation, customers want a corporation to present a unified face. Existing businesses can still have difficulty managing their operations properly from start to end. As a result, new sales and distribution channels are more difficult to negotiate, customer interactions are sluggish, and it is more difficult to make complex, unique items on schedule and under budget.

Methods for increasing productivity that are well-known include imposing ambitious targets from the top, delegating responsibility to cross-functional teams, standardizing processes, and enforcing stricter execution standards. Nonetheless, putting these ideas into reality is a quite other thing. Crucial cross-business communication is hindered by the internal complexity that arises when separate departments claim and tenaciously defend control over distinct processes and data. In addition, we've discovered that companies that rely on tried-and-true methods (such as lean and business-process reengineering) either overburden their managers by attempting to revamp every process across all business units or, alternatively, fail to see the forest for the trees by focusing solely on their own functions.

#### **4.2.4 Merchandising**

Merchandising is the practice of promoting things to improve sales. Product promotions may involve a change in pricing, attention-grabbing displays, special offers, or other means of influencing a customer's purchasing choices. To improve sales and profits, retailers base merchandising on the concept of providing a product at the appropriate price, right time, right location, and right quantity. Merchandising tactics vary based on the retailer's objectives,

product category, and brand. Merchandising often pursues a particular objective, such as generating sales, fostering consumer loyalty, increasing foot traffic, or enhancing brand exposure. (Indeed Editorial Team (2021) Merchandise and merchandising: What's the difference?)

- **Manage product development lifecycle:** Product lifecycle management (PLM) is the process of monitoring a product as it progresses through the many stages of its life cycle, from conception through obsolescence.
- **Platform customer & market analysis:** Because not everyone is interested in purchasing customized Air Jordans, bacon-flavored soda, or organic soap made from peanuts, it is essential to conduct a thorough customer and market analysis on your platform in order to allocate advertising funds wisely and increase sales through organic channels.
- **Category and Basket Analysis:** Market basket analysis is a data mining approach that examines patterns of co-occurrence and evaluates the strength of the relationship between items bought together. It is also known as frequent item set mining and association analysis. By discovering the links between the things a client has purchased, it is possible to comprehend the consumer's behavior. Simply stated, market basket research informs merchants of the goods that are commonly purchased together so that they may maintain adequate inventory levels.
- **Develop / manage plans for products sales and pricing:**

#### **Positioning and pricing techniques**

In the pricing strategy portion of your marketing plan, the main purpose is to establish a price for your product or service. You must establish competitive prices while yet generating a profit.

Maintain reasonable pricing; you are allowed to establish them at whatever level you wish, but there is a limit to what customers will pay for any particular product or service. This buying power level must be accounted for in your pricing strategy.

#### **Plan of Distribution and Sales**

Always remember that sales growth is the holy goal of all marketing strategies. Here, describe the measures that will be done to achieve this.

There are normally three subheadings inside the sales and distribution section, however not all of them may apply to your business.

## **Distribution Techniques**

- Asking, "How will the product or service be delivered to the end user?" How will you distribute your products to consumers? Will it be offered online, by mail, by salespeople in person, by direct home delivery, or in retail stores?
- How will this merchandise be distributed? The phrase "direct distribution channel" refers to the path a product or service takes from its point of origin to its end consumer. A direct distribution channel consists of a direct path from the manufacturing to the retailer to the client. The traditional distribution chain starts at the plant and progresses via wholesalers, retailers, and end consumers. Describe in detail the many organizations, employees, and infrastructure components that must collaborate to bring your product or service to market.
- What are the related distribution costs?
- What are the terms of delivery?
- How will distribution techniques effect manufacturing timelines or shipping? How quickly will your goods or service reach the customer?

If you are in the business of selling items, this area of your marketing plan should describe your inventory and packaging alternatives in depth.

- Important considerations include "What kind of retail and delivery packaging will you employ for your products?"
- Does the product adhere to all statutory requirements (such as labels)?
- Does the product's packaging represent its price and value accurately?
- How much inventory should always be on hand to minimize sales reductions brought on by stockouts and backorders?


## **Transacting Procedure**

- Who will be in charge of handling orders, shipping, and payments?
- Questions such as "What payment methods do you accept?" are crucial for prospective customers to know.
- What kind of financing alternatives will be accessible to purchasers? In this portion of your marketing plan, you must explain if you will provide a discount for early payment and whether you will impose penalties for late payment.
- In what manner are returns permitted?
- Exist any assurances that the customer will be satisfied? Specify all of these

guarantees, as well as any more that may be provided.

- What kind of post-sale support will you provide, and how much will it cost (if any)?
- Is there a means for customers to submit feedback on their experience, so that service faults (or lack thereof) may be detected and addressed?

### **Sales Methodology**

- There will be commissioned salespeople, product demos, cold callers, etc.
  - Inform the sales personnel of your expectations and how their work will be assessed.
  - Inquiry: "Do you give sales training?" In such case, please elaborate in this section of the marketing plan.
  - Specify the incentives that will be offered to salespeople to inspire them to achieve their objectives (such as getting new accounts, the most orders, etc.).
- **Source management:** When an organization emphasizes the maximizing of organizational value, resource management, also known as resource planning, is implemented. Resources may be intangible, such as time and knowledge, or tangible, such as cash, equipment, and materials.
-   
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- Essentially, resource management is planning one's calendar such that available resources are used most effectively on specified tasks at particular times. Managing resources include planning and allocating cash for tasks, activities, and purchases involving people, projects, equipment, and materials.
- **Supplier collaboration:** In the context of the supply chain, the significance of a business's suppliers cannot be understated. The quality of a company's suppliers has a substantial impact on its overall success or failure, regardless of the industry in which it works or the kind of product it manufactures. Consequently, supplier-customer relationships are of the highest significance.

### **4.2.5 Fulfillment**

When a customer's order is complete, it is processed and forwarded to them. Online merchants and smaller businesses often outsource their order fulfillment to e-commerce-exclusive companies. This is in contrast to larger enterprises, such as catalog retailers, which



often have the ability to handle customer orders internally. ((2022, November 25). What Is Fulfillment? Definition and Guide)

- **Global supply chain:** Manufacturers and industries are more efficient and profitable as a consequence of the global supply chain's capacity to reduce costs and promote company development into international markets. Global supply chain management is primarily concerned with the management of international supply chains that comprise several suppliers, manufacturers, warehouses, shippers, distributors, and retailers.
- **Manage inventory / distribution:** Businesses must successfully manage their inventory and deliver items to customers in order to maximize earnings. Inventory management, a crucial component of the supply chain, tracks the movement of items from the manufacturer to the warehouse to the retail location. Inventory management requires consumables to be accessible when and where they are required.
- **Supplier collaboration:** Collaboration with suppliers is not a word used to all supplier relationships, but rather a well-structured engagement program that yields major advantages for both the buying organization and the supplier. Working with suppliers is time-consuming and requires more personnel than the buying department alone. In order for a collaborative collaboration to be successful, companies cannot just "hang around." Before commencing a complete cooperation plan, it is essential to pick your suppliers with caution.
- **Coordinate transport and logistics:**

**Logistics investigates each action required to fulfill an order.**

Logistics comprises the whole of a supply chain, from the first order through the delivery of completed goods in the client-specified quantity. The strategy will also govern how your firm manages inventory management, order status updates for clients, and delivery. In its most basic form, logistics is the department responsible for fulfilling orders according to specifications and meeting client expectations. It is a combination of science and imagination.

**The emphasis of the area of transportation is the logistics of transporting commodities.**

Shipping is the transportation of goods from one location to another for the purpose of economic exchange. It is an often-overlooked area in logistics. Companies ship their products by land, air, and ocean.

- **Pick, pack, and ship:** Every consumer worries about the same things: obtaining the correct goods quickly and in good condition. The consumer is unaware of "behind-the-scenes" or

post-order actions.

After a request for an order has been made, it undergoes many stages. This resembles a trip to the grocery shop to get the necessary products. You have a list of all the things on a single sheet of paper, and you are searching the store's shelves for the items on your list. Therefore, whenever the warehouse gets a request for an online-ordered goods, it undergoes a number of operations prior to being sent.

- Digital Product Delivery, or DPD, is a self-funded ecommerce service provider specializing in the sale and delivery of intangible commodities such as PDF ebooks, music and video, and other document and media formats. DPD also offers physical commodities, service products, and subscriptions to digital content.

DPD focuses in providing beginner sellers with sophisticated functionalities via an intuitive and logical interface.

DPD began as a side project for the creators when they were doing independent contract work and was made available to the public after friends indicated interest. Since then, DPD has grown to offer ecommerce services to over 5000 firms and home-based businesses in the software sales, internet marketing, eLearning, and independent music industries, generating millions in yearly sales.



A firm's technology solutions may be enhanced by a deeper understanding of the customer journey between the firm and its clients.

From discovering about your shop for the first time to obtaining after-sale care and beyond, the retail customer journey describes the stages a customer takes. After a client has completed a purchase, your organization may cultivate a long-lasting relationship with them in an effort to keep them as repeat consumers. By examining the pathways clients take while shopping at various establishments, business owners may get insight into their customers' experiences and enhance their customer service.

### **What common processes does a customer follow while shopping?**

There is a structure to a customer's journey through a shop. Customers often follow the actions outlined below in retail settings:

#### **Awareness**

Awareness is the first step in a consumer's brand knowledge journey. When a customer

perceives a need and discovers that your product may fulfill that need, the process begins. This is the first step of the customer engagement process. To further comprehend this stage, consider the many advertising initiatives that attract buyers to you.

### **Engagement**

Once a customer recognizes that your product or service may be the solution to a problem they've been experiencing, they will likely seek you out online or at your store. The customer is now in the engagement phase, during which they actively contribute in the growth of your brand. Depending on your company's demands, customers may chat with sales representatives, request a demonstration, or browse your website.

### **Consideration**

After learning about your brand and beginning to engage with it, a customer enters the contemplation phase. This is the time at which a prospective customer begins to consider purchasing from your firm. They've determined that your organization can assist them, but they're unsure whether you're the best choice.

### **Purchase**

A customer eventually commits to purchasing your products or services during the purchase phase. This climax stage of a customer's purchasing experience determines, to a considerable part, whether or not they will become repeat customers. Accessibility is especially crucial at this point since it ensures a seamless and effortless purchasing experience for customers. The customer-business connection formally begins with the transaction.

### **Post-purchase**

The period that occurs after a customer makes a purchase is known as "post-buy." This is when the firm contacts the client again, often via a survey or newsletter, to guarantee continuing involvement with the customer after the transaction. After a customer has completed a purchase, there is still an opportunity to strengthen the relationship and benefit both sides.

Retail Customer Experience Journey example:

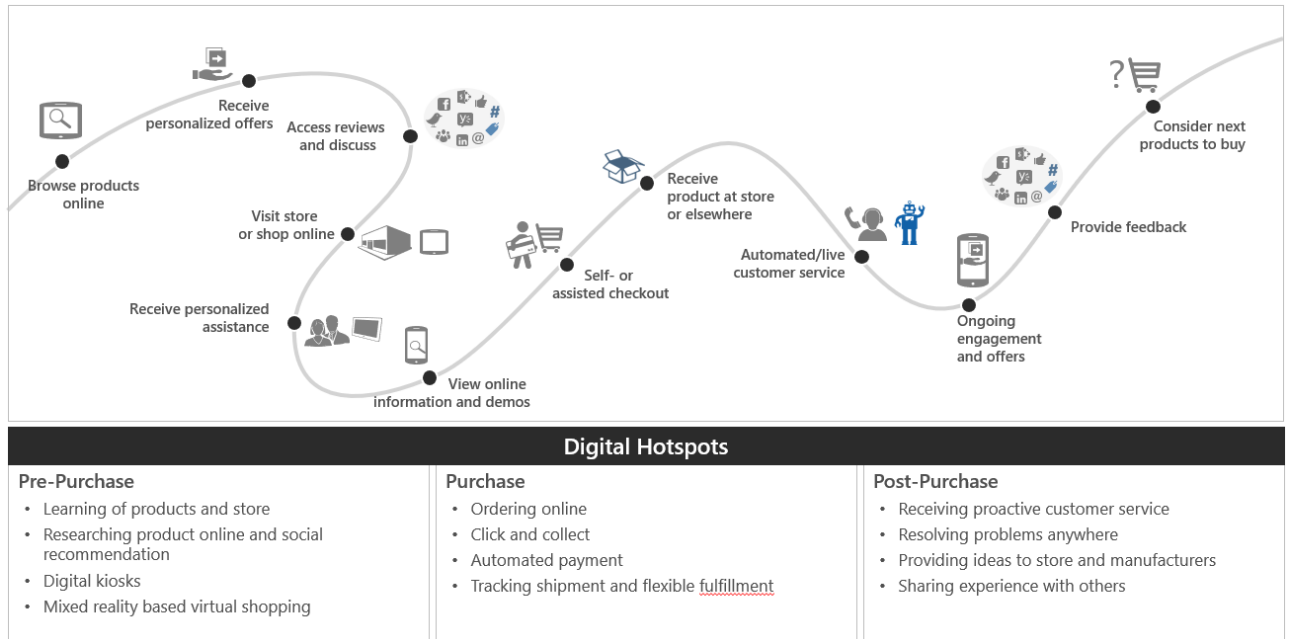


Figure 14 Retail Customer Experience Journey

Digital Hotspots are what technology can support to optimize the journey.

In pre-purchase applications can support for

- Learning of products and store
- Researching product online and social recommendation
- Digital kiosks
- Mixed reality based virtual shopping

In purchase phrase:

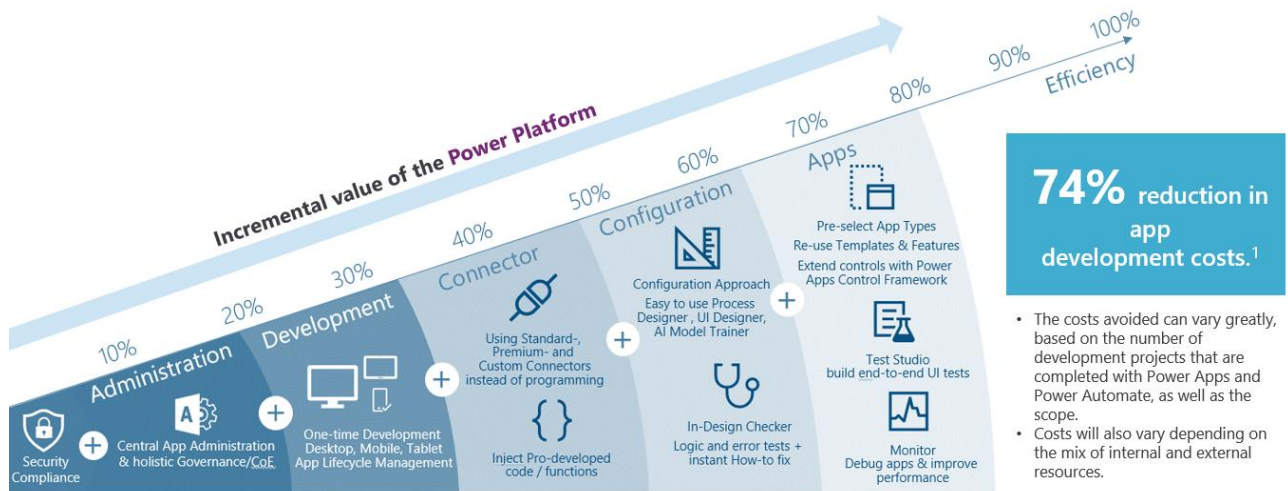
- Order online
- Click and collect
- Automated payment
- Tracking shipment and flexible fulfillment

Post-purchase stage:

- Receiving proactive customer service
- Resolving problem anywhere
- Providing ideas to store and manufactures
- Sharing experience and others

## Reduce time and cost building business applications

Enterprises adopting the Power Platform have provided examples of how the platform reduces IT cost and effort.



1. Forrester Research, *The Total Economic Impact™ Of Power Apps*, March 2020.

Figure 15 Reduce time and cost building business applications

Microsoft commissioned a Forrester Overall Economic Impact research for the Power Platform in order to provide customers with further information on the value of the platform's advanced capabilities. This report describes how the platform's premium features enable companies to utilize the platform's full economic potential.

This is accomplished by emphasizing the three most prominent benefits of Microsoft's premium Power Platform. The first is demonstrating that the broad adoption of low-code solutions has little disruptive effects on major organizations. The second objective is to eliminate all obstacles to establishing enterprise-level security so that even low-impact projects may reap the rewards. Thirdly, we can lower the costs associated with the traditional development and upkeep of legacy applications.

According to Forrester's study, their composite firm properly portrays the typical Microsoft Power Platform client using premium capabilities, since it was derived from interviews with four customers and surveys with thirty-eight others. The merged organization will operate similarly to a \$3 billion, 10,000-person multinational with the same revenue.

Customers may expect an NPV of \$8.32 million, a ROI of 502% from the regular Microsoft Power Platform and an additional ROI of 140% from the premium features, a 46% decrease in

application development expenses, and a 46% reduction in overall costs over the course of three years.

### **I. Enhanced scalability of enterprise-wide low-code solutions**

These figures are the outcome of the premium characteristics of low-code solutions, which allow the elimination of data silos, the proliferation of code reusability, and the development of governance and security standards throughout an enterprise. Outside of Microsoft Teams, enterprises who have acquired a premium license for the Microsoft Power Platform have access to the Microsoft Dataverse service. This solution was created to simplify data administration and management.

Users of Dataverse are able to clean their data by mixing it with data from other sources. Since the data and programming may be used in several ways, the organization can expand further. Prior to the release of Dataverse, enterprises had to develop their own solutions from scratch or rely on SharePoint or other ad hoc solutions that were incapable of managing huge or complicated data models.

According to the head of Microsoft Power Platform at a transportation business, the organization's efficiency rose after adopting the low-code concept and reusing code using Dataverse. This assertion is supported by the fact that the corporation began recycling code. They said, "Thanks to the Dataverse, we have far more possibilities for duplicating applications." If a candidate has already applied, others will contact them. They will place it in a box and give it to him. Almost verbatim, he revises and reuses it.

### **II. Elimination of obstacles to citizen growth for enhanced low-code effect**

When obstacles to citizen development are lowered, low-code technologies become more accessible, and the invention of valuable solutions by regular people is enabled. This expedites corporate procedures and increases the bottom line. Without the premium capabilities of the Microsoft Power Platform, several businesses were unable to share their data safely and efficiently. This reduced the pace at which applications could be produced, and as a result, a number of pressing issues were never removed from the IT backlog. Customers with a paid subscription may provide their citizen developers access to Dataverse, as well as premium data connectors and Managed Environments.

IT departments can easily scale up to enterprise-level governance and security with Managed

Environments and the center of excellence launch pack, ensuring compliance throughout the whole business. Previously, data silos prevented citizen developers from accessing Dataverse's integrated data, but this obstacle has been eliminated. Lastly, premium connections enable non-technical users to accelerate application development by using key databases such as SAP and custom APIs developed by professionals.

In three years, easing the path for citizen developers to join the workforce will provide a \$7 million return on investment, and improved business performance will generate an additional \$3 million. A solution architect in the banking sector said, "[Microsoft Power Platform has] increased the number of citizen developers by making low-code [and] no-code platforms widely available," stressing the difficulty of getting comparable outcomes via more conventional methods. This indicates that numerous businesses are now contributing to the creation of new systems and technologies. These individuals significantly depend on the Power Platform since they have no other methods of constructing such systems.

### **III. Decreased costs for traditional application development and maintenance**

The third advantage of Microsoft's premium Power Platform is that it allows for the building and maintenance of legacy applications for a fraction of the expense incurred in the past. One of the many advantages of low-code technology is the ability to phase out outdated software and more rapidly adopt digital processes. As a consequence of low-natural code's ability to accomplish more with less, firms may save time and money by retiring ineffective existing applications rather than developing new ones.

This innate capability is enhanced by Managed Environments' streamlined governance and security, Dataverse's removal of data silos, and premium connectors' easier API re-use. As a consequence of these sophisticated features, an average of 54 percent of aging programs were terminated.

Over a three-year period, the corporation saved \$496,800 by removing obsolete projects and \$3,800,000 by abandoning conventional development techniques.

### **The blueprint for cross-organization impact**

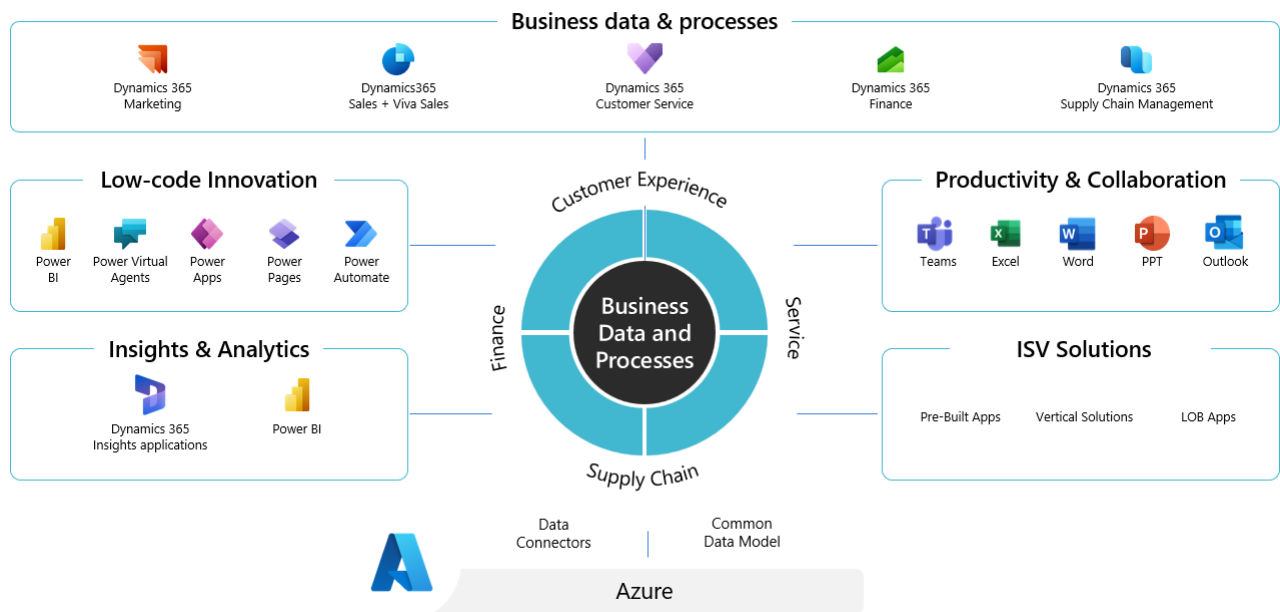


Figure 16 The blueprint for cross-organization impact

At the infographic indicates Microsoft Office 365 ecosystem solutions can cover almost SMEs' business requirements.

- In Customers Experience: Dynamic 365 solution can cover for: Marketing, Sales, Customer Service, Finance and supply chain management.
- For Finance, Supply Chain, Service: other solutions follow categories: Low-code Innovation, Insights & Analytics, Productivity & Collaboration and Independent software vendors (ISVs) Solutions.

After establishing the theoretical framework and adhering to basic design principles, it was time to implement the findings and validate the design principles. Initial stakeholder research accompanied a comprehensive grasp of the Microsoft Power Platform. This helped to highlight the initial design concept that required participation from all departments. These people, selected based on their status within the organization, reflect the diverse viewpoints of the group. To bring the theoretical concepts and stakeholder study findings into reality, a conceptual design for implementation was built.

Environments and Connections, Monitoring, and Miscellaneous are the most crucial components of the Conceptual Design. These three zones were created as a direct consequence of the unique qualities of LCDPs. Environments and Connectors relate to the techniques through which applications interact with the outside world, whilst Monitoring is the activity of carefully evaluating these relationships ("Miscellaneous"). As part of the



overarching phrase "Environments and Connections," the following three issues have recently come to light: Each department is responsible for the programs operating in its "environment," and only non-essential connections are prohibited. First, each section is tasked with maintaining its own environment.

There are two appointed "owners" for each division. Depending on the context and division involved, some linkages may be restricted or loosened more stringently. This depicts LCDPs' remarkable capabilities properly. Information technology also simulates real-world environments in order to test applications. In this environment, the overall threat to the group is less. Two topics were discussed in the monitoring section. Let's begin by discussing how to use Microsoft's Power Platform enhancements. This involves capturing applications running on the Microsoft Power Platform and detecting changes in the Microsoft Power Platform's functional scope. Nonetheless, this entails regulating the amount of distinct kinds of connections so that the essential activities may be executed.

The "Other" section contains all the supplementary material that supports this concept. The IT department's provision of essential resources is one example. This means that the development-responsible departments also get aid for their own growth and development. Depending on available budget, IT may also offer consulting services "as needed." Similarly, the organization's procedures, such as the one for launching new environments, must be specified. The different decision areas are the responsibility of the board created in accordance with the governance standards intended for LCDPs. The owners of ecosystems often convene at this board. Architecture, best practices, and acquired knowledge are the topics of discussion in this forum. Included in the accompanying archetypes are talks on management and governing problems. After the initial concept design was given for approval to the practitioner group, a poll was undertaken, and the findings are represented in Table 2.

<b>Practitioners</b>	<b>Feedback</b>
Compliance	Reduced constraints
Data Protection	Evaluate economic impact
Cyber Security	Enhanced monitoring requirements
IT Operations	Customized adapters
Global Applications	"Hull" generation

Table 2 Responses from practitioners

Table 2 displays the comments from practitioners. Each expert was provided with the same question. In the survey, respondents were asked how they regarded the overall idea and which components they deemed to be the most essential. This feedback is reflected in the amended version of the concept. Certain elements have been introduced locally: In response to the question about Environments and Connectors, it was suggested that specialized connections be temporarily disabled and closely monitored.

Setup of monitoring to verify connections" and "Verification of developer privileges" were the two elements listed under "Monitoring." In response to the submitted input, some adjustments were made. As a result of the IT Operations department's focus on bespoke connections, monitoring was established and tailored specifically for them. To mitigate the possibility of "hull" creation, it was proposed that developer permissions be reviewed. Hull generation refers to the potential for "external" and hence illegal individuals to enter a place. This danger is mitigated by examining the data's rights and connections. Practitioners were provided with the resultant final idea. Feedback Compliance less constraints Data Security Consider business consequences Internet Security Greater demand for IT Operations monitoring Customized adapters Worldwide Applications "Hull" generation.



At each phase of the evaluation process, input from both professionals and end users is included. The majority of community members supported the proposition. The user group put a high value on features that assisted end users in maximizing the platform. Hence, the third principle is to facilitate user compliance by providing them with compliant and well-designed resources like as guides, manuals, and user interfaces. For governance implementation to be effective, end users must be assisted throughout these processes. The fourth stage of ADR is based on the idea of generalized outcomes, which underlines the difficulty of generalization since the artifact was designed to solve a unique issue. To allow practitioners and researchers to produce comparable products, the design principles were established. These domains were used to identify and cluster the needs. Table 3 outlines the extraction of design principles from categorised criteria to meet the overall issue class of LCDP governance.

<b>DP</b>	<b>Description</b>
DP1	Clarification of duty and future provision via classification of current applications
DP2	Early and ongoing participation of business units in gathering needs and making choices

DP3	By offering guidelines, documents, and compliant interfaces, you may aid end-users in achieving compliance.
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Table 3 Generalized design principles

Throughout the course of this investigation, certain design elements that lead to LCDP governance emerged. On the basis of these design principles, alternative LCDP governance may be developed. The design principles provide information about how solutions are constructed (in this example, LCDP governance), which may be used to create further instances of the same class.

On the other hand, Outsystem and Mendix are competitor of Microsoft Power Platform

- **Mendix** – The platform's plethora of pre-built templates and modules makes it a leader in Gartner's Magic Quadrant for corporate LNCP platforms. As a result, developing online and mobile apps with Mendix is a snap. The learning curve is minimal, and you may accelerate the manufacturing of apps. Also, you will not need to be concerned about syntax problems.
- **Outsystems** – Omnichannel apps represent the platform's greatest strength. Outsystems offers quick application development without major modifications to the current IT infrastructure by linking the underlying data. Despite its ubiquity, developing complex applications for it demands a thorough understanding of the underlying technology.
- **Power Apps** – A software development toolkit is a collection of many components that simplify the development, automation, and evaluation of software. The Common Data Model serves as the basis for the sharing of data and operations across programs. Microsoft's Power Platform provides significant flexibility and scalability for basic applications. In the case of complicated applications, you must utilize Microsoft's Azure app service and other technologies.

When it comes to fulfilling your needs, comparing Power Apps, Mendix, and Outsystems may assist you in selecting the most appropriate alternative.

### Power Apps

- **Functionality: Essential Skills** Microsoft Power Apps offers a uniform environment for designing fundamental business apps. While developing complex applications, it is required to deal with several formulas. This platform will feel familiar to those who

are already used to the Microsoft ecosystem. In compared to other systems, the platform's logging and monitoring capabilities are subpar. Access to other Microsoft applications is all that's required to develop complex software.

- **Support:** You may seek assistance from Microsoft's huge user community. Per-user or per-app subscriptions are available for the license.
- **Usability: Ease of Use -** Developing Web and mobile applications with Microsoft Power Apps is simple. When integrated with other Microsoft technologies, it offers solutions to a variety of online challenges faced by contemporary enterprises. It is suited for both small and large businesses.
- **Cost:** Although Microsoft Power Apps has fewer functionality than its competitors, it is more cheap. However, the price increases according to the amount of Microsoft products used.

### **Mendix**

- **Functionality:** Mendix provides comprehensive support for the various stages of an application's lifecycle. It is equipped with a local testing environment and provides ongoing quality assurance. Moreover, it provides excellent tracking and logging features. There is no need to manually swap between modules since it is model-based.
- **Support:** It has the biggest user community, which offers answers to a variety of problems on an ongoing basis. Mendix Marketplace is distinctive and provides a wide variety of goods to improve your applications. According on the number of users and environments, Mendix is licensed.
- **Usability:** Mendix bridges the gap between IT and the rest of the business by focusing on the commercial aspects of app development. Thus, its target market consists mostly of corporations and SMBs.
- **Price:** Comparatively less expensive than Outsystems, though not by much.

### **Outsystems**

- **Functionality:** Outsystems delivers app development-accelerating capabilities that may be customized by IT specialists. Outsystems, unlike rival alternatives, provides you total control over which attributes are made public. The functionality for combining artificial intelligence (AI) with the Internet of Things (IoTs) is superior than that of competing products. It lacks an independent testing environment, unlike Mendix.
- **Support:** Community assistance from Outsystems is inconsistent at best. A further distinction between Mendix and the rest of the market is the paucity of choices offered

by the latter.

- Usability: It has a severe learning curve, therefore only seasoned IT professionals should try to utilize it. This is acceptable for both small and large businesses, but novice programmers cannot be relied upon.
- Price: The overall cost is determined by a number of variables, including the number of users, the cost of hosting, and the service level agreement. The initial expenditure is more than with Mendix and Power Apps. Costs cheaper than Mendix as enterprise size grows.

If a small or medium-sized organization employs a Microsoft-based IT infrastructure, the Microsoft Power Platform and other associated products may provide a comprehensive solution. Mendix and Outsystems solutions are ideal for businesses of any size. Your requirements for a low-code development platform and how you want to structure your application landscape will decide the optimal platform.

Other than Mendix and Outsystems, small and medium-sized enterprises (SMEs) can only anticipate minimal modifications to their digital transformation procedures from other platforms. These alternatives are not as dominant in the commercial IT field as Microsoft's Power Platform.



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## Chapter 5 - Conclusion

Businesses with 200 or less employees are categorized as small and medium-sized (SME), thus it makes sense that governments over the globe are concentrating on assisting smaller enterprises in expanding as a way of national development. Notwithstanding their numerical advantage, the fundamental significance of SMEs rests in the fact that they are the major engines of job creation, economic growth, and technical innovation. In developed countries, according to the World Trade Organization, SMEs account for more than 90 percent of firms, 60 to 70 percent of employment, and 55 percent of gross domestic product (GDP).

Low/No-Code development might exploit the opportunity offered by the need for digital transformation inside enterprises to demonstrate its utility. As the move to digital proceeds, business application requirements will become more specific and intricate. Due to the benefits of NC, organizations may be more responsive to industry developments; nevertheless, the LNCD systems may need more customization and adaptation.

During the preparation of this study, factors such as enhanced agility, lower costs, and faster app development and delivery, among others, were highlighted as essential considerations for the automation of software development tools. Businesses may be less likely to adopt low-code if their staff are averse to change, which is unsurprising given people's innate reluctance to adjust their behavior. However, if the company's IT department does not check and sanction the technology being utilized by the business, its adoption in a rush may give birth to "shadow IT." This creates compliance and security issues as well. Future prospects for the low-code paradigm are still unknown.

After evaluating the current literature, we can conclude that low-code technology is understudied as a tool for automating software development, which is a vital step toward establishing more trust in this area. Despite the absence of research, open source, a developers' center, messaging, and Pub/Su have been identified as the most essential elements of a low-code development platform. Next, vf-OS was compared to various low-code development platforms to assess their respective strengths. Several findings have been taken from this study, and they all point to the absence of open-standards-based, cross-cutting platforms for the formation of ecosystems appropriate to the automated development and distribution of software applications.

For small and medium-sized organizations in particular, Low-Code/No-Code Development will prove to be a revolutionary tool in the digital transformation and software development industries (SMEs).

## Chapter 6 - Future work

Every aspect of life is increasingly reliant on technology. The need for mobile applications and related solutions continues to increase. This enormous demand has created a shortage of IT professionals. LCDP enables "citizen developers" who are not professionally educated software engineers to construct their own applications from start. LCDP expedites, simplifies, and reduces the amount of code required for app development. For the majority of the development, graphical user interfaces and drag-and-drop components are heavily used.

This study examined the reasons of LCDP usage and the challenges associated with its implementation. Also, it illuminated the factors that impact or limit the adoption of LCDP by particular developers. LCDP was selected by many software developers and designers over more standard approaches. LCDP's promise of speedier app development, a simpler interface, more dependable code, enhanced step-by-step instructions, and fewer errors drew them to the platform. Despite this, engineers and programmers discovered various difficulties with LCDP. The most frequent problem was a lack of control over the display of pre-existing platform elements.



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LCDP, like every technology, has advantages and disadvantages for programmers and developers. They are significant considerations that influence developers' choices to use LCDP for application development. In certain circumstances, developers prefer conventional programming over LCDP. Some of these obstacles include limited scalability, security threats, and difficulty connecting LCDP applications with other systems.

In addition, researchers must perform more investigations and assessments in order to uncover the sources of LCDP's difficulties and present realistic proposals for their resolution. The LCDP experience for developers and programmers might be better if these issues are resolved. In addition, this may inspire those who do not already use LCDP to start doing so. The primary obstacles to consider are the limited scalability of the created apps and the security issues that develop while using LCDP.

Moreover, LCDP providers are encouraged to improve the developer experience on their own platforms. The built-in characteristics of these systems should be more susceptible to change by programmers. In addition, service providers should consider ways to enhance the security

of LCDP-built apps. The generated code must also be more human-friendly, with descriptive variable names and unambiguous comments. Using this way, it will be easy to update and alter the code.

It is suggested that, in the future, the survey be performed to a larger number of developers and programmers in order to completely comprehend the factors, benefits, and concerns related with LCDP.





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