

# NO-CODE DEVELOPMENT PLATFORMS: BREAKING THE BOUNDARIES BETWEEN IT AND BUSINESS EXPERTS

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## Abstract

*The importance of Low-code and No-code technologies is increasing due to the lack of companies' internal knowledge about traditional programming languages and the difficulty in recruiting professional programmers to speed up the applications' development process. This study aims to understand the impact of Low-code and No-code development platforms (LCDPs and NCDPs) on business dynamics as tools that potentially enable bridging the collaborative gap between business and Information technology (IT) experts. The topic's novelty encourages an explorative research approach designed by following a case study strategy and adopting a qualitative semi-structured interview and the card-based game method to support data collection. Two companies in different countries and sectors were involved, and four key informants were interviewed. The evidence of the analysis shows the primary reasons that have encouraged companies to adopt such tools. The reasons mainly reside in the possibility of speeding process automation and applications development and learning how to use the platform autonomously, empowering collaboration among business experts and IT professionals, and increasing customer satisfaction. The study represents an additional contribution to the importance of LCDPs and NCDPs as tools that allow faster automation of processes and easier development of software and application in different sectors.*

**Keywords:** No-Code development platforms; Low-Code development platforms; LCDPs; NCDPs; Digital technologies; Process automation; Apps development; Cooperation.

## 1. Introduction

Today, digital technologies strongly affect society and how companies run their businesses, encouraging the increasing adoption of new technologies to stay competitive. In this respect, implementing LCDPs and NCDPs (Prinz et al., 2021; Ihrwe et al., 2020; Richardson & Rymer, 2014) is important for those companies that aim to speed up the

software and application development process but lack knowledge about programming languages. LCDPs and NCDPs offer a development experience based on visual and drag-and-drop techniques rather than traditional programming languages (Outsystem, 2019), which is heavily reduced, favoring a faster deployment of software and applications and the predisposition of multi-level workflows (Prinz et al., 2021). Such technologies have the potential to democratize IT by accelerating programmers' activity and allowing the participation of several stakeholders in the software and applications development process. Accordingly, users with little knowledge of traditional programming languages learn how to create the products they need without writing code.

Moreover, the progressive implementation of LCDPs and NCDPs accelerates the firms' digital transformation process (Outsystems, 2019). They increase companies' flexibility in answering market requests supporting their quick adaptation to variable conditions and customers' requirements and reducing the dependence on technical skills that are difficult to recruit (Rokis & Kirikova, 2022; Bernsteiner et al., 2022).

The current literature underlines that the importance of these technologies is directly related to their impact on companies' experience in developing software and applications, as they encourage a more flexible process and, consequently, a significant change in the company's daily activity. According to Prinz et al. (2021), most literature focuses on the benefits of LCDPs and NCDPs and their challenges, mainly referring to technical aspects (e.g., specific LCDPs/NCDPs features, tools offered by specific LCDPs/NCDPs) more than the social ones. These authors highlight the need to develop more studies on the impact of these platforms on social aspects to provide "*a more holistic view*" (p. 7) of this emerging phenomenon. For instance, factors such as the impact of LCDPs and NCDPs on IT and business experts' collaboration and communication remain underexplored. Therefore, there is a need for further empirical insights in the managerial literature to understand better the impact of these technologies on IT and business units' cooperation and the related changes triggered once they are introduced inside the company.

By focusing on the impact of LCDPs and NCDPs on organizational dynamics, this study would like to answer the following question: *How does LCDPs/NCDPs implementation affect the cooperation between IT and business experts?*

More in detail, the research aims to understand the impact of LCDPs/NCDPs implementation on business dynamics with specific reference to the cooperation – meaning collaboration and communication - between business and IT experts in developing specific activities to reach their business goals. Due to the topic's novelty, the author was encouraged to adopt an explorative research approach by developing a case study strategy (Yin, 2018) and implementing a purposive sampling technique (Patton, 2002) that facilitated data collection from key informants. Such an approach helped the authors to have a deeper understanding of the direct experience of using these platforms and the changes they have brought inside the companies allowing the contamination of knowledge between experts.

The subsequent sections of this article review the literature on LCDPs and NCDPs by addressing the gap the study aims to fill. The methodology section describes the qualitative approach implemented through the development of the case study, including the firms' profile description. The finding section shows the main results of the analysis conducted, and the discussion and conclusion explain the importance of the evidence that emerged from data analysis with suggestions for future research.

## 2. Literature Review

### 2.1. LCDPs and NCDPs characteristics

Today, it is critical for firms to adapt their strategy and way of working to the unpredictable environment in which they operate (Yan, 2021; OutSystems, 2019). The rapid development of IT and the speed of digital transformation require new tools to face the volatility of the environment and support internal changes (Yan, 2021; Sanchis et al., 2020).

Digital transformation encourages companies to shift from a time-consuming working method to an agile approach based on digital technologies (Alsaadi et al., 2021). Such an approach suggests a more flexible way of working and favors seizing new market opportunities and satisfying customers' requests by staying competitive (OutSystems, 2019).

Moreover, the increased adoption of smartphones has led to an increased release of mobile-based applications (Hyun, 2019). Therefore, companies need to adopt tools that help them implement rapid changes according to users' requests and business needs (Rokis & Kirikova, 2022). Indeed, instead of adopting expensive tailored IT solutions, companies can opt for disruptive technologies such as the LCDPs and NCDPs that help change the applications' development process (Moskal, 2021). Such technologies are gaining popularity due to the increased digital transformation (Beranic et al., 2020; OutSystems, 2019) by registering a growth in their adoption during the Covid-19 pandemic when remote working imposed the digitalization of several processes and workflows (Chandran & Abdulla, 2022).

LCDPs and NCDPs are cloud or on-premises-based platforms (Rokis & Kirikova, 2022) that enable quicker development of applications avoiding the use of hand-coding languages, asking for less effort in the "*installation and configuration of environments, and training and implementation*" (Waszkowski, 2019, p.376). They represent essential tools for those users that aim to automate processes and build software solutions without having IT skills (Rokis & Kirikova, 2022). Indeed, the pre-coded components, visual diagrams, declarative languages, modules, and templates allow users to create applications by dragging and dropping different elements (Chandran & Abdulla, 2022; Beranic et al., 2020). In addition, costs and time spent on developing applications by using both LCDPs and NCDPs are lower if compared to traditional coding programming (Moskal, 2021; Rymer, 2017; Khorram et al., 2020). For instance, software and applications development generally takes nine to twelve months using traditional programming languages, while LCDPS or NCDPs takes a few weeks (Chandran & Abdulla, 2022).

Despite the terms "low-code" and "no-code" are often used interchangeably, LCDPs and NCDPs present some distinctions (Rokis & Kirikova, 2022; Marinković & Avramović, 2021; Vincent et al., 2019). More in detail, LCDPs maintain the possibility of integrating lines of code using traditional programming (Khorram et al., 2020). Indeed, they ask for minimum usage of manual coding to complete (or tailor) and release the application, favoring the development of more complex software, therefore, asking for some programming skills (Chandran & Abdulla, 2022). For this reason, LCDPs are mainly addressed to advanced users and skilled developers (Marinković & Avramović, 2021) or to companies with an IT unit that can complete the customization of the product. In this case, the primary intent is to reduce developers' repetitive activities due to adopting the traditional programming language, thus reducing the time dedicated to monotonous application development details (Yan, 2021).

In contrast, NCDPs represent a subsection of low-code technologies. They are generally adopted to create reporting, analytics, and tracking apps (Chandran & Abdulla, 2022), favoring quicker prototyping according to customers' requirements and testing functionalities as they do not request programming skills to be used. NCDPs are highly adequate when a company lacks IT resources or when professional developers' availability is lacking in the market (Rokis & Kirikova, 2022; Yan, 2021). They are mainly suitable for the so-called "citizen developers" (e.g., business users, office managers, small business owners, and users without IT background) (Bernsteiner et al., 2022; Prinz et al., 2021) as they enable an active contribution to the process of creation of software and applications (Rokis & Kirikova, 2022; Marinković & Avramović, 2021; Beranic et al., 2020; Wong et al., 2019) even lacking hand-coding programming skills.

In addition, organizations are coupling LCDPs and NCDPs with workflow automation tools as complementary (Lebens et al., 2021). Such an approach facilitates the inclusion of unskilled IT employees, such as business experts, in product and process development, enabling them to create what they need without writing code. This combination supports the inclusion of employees from different departments in the company's digital transformation, making them active contributors.

## 2.2. Citizen developers' strategy

Due to the limited IT resources in several companies, business units face difficulties in enhancing their processes quickly (Lebens et al., 2021) and fulfilling the increasing need for web and mobile applications (Bernsteiner et al., 2022).

LCDPs and NCDPs are tools that accelerate companies' digital transformation, improving the responsiveness of the business by decreasing the dependence on professional programmers that are difficult to hire (Bernsteiner et al., 2022; Outsystems, 2019). Moreover, they facilitate a much faster and cheaper launch of digital products and applications (Lebens et al., 2021), minimizing barriers to software development (Silva et al., 2021). They allow business departments to make their employees create autonomously the products they need, lowering the pressure on the IT department (Lebens et al., 2021). In addition, professional programmers and IT units can benefit from LCDPs and NCDPs to enlarge their portfolio of products by developing projects without spending months on a project (Moskal, 2021). For this reason, such tools have the potential to accelerate the time of applications' release (Khorram et al., 2020), facilitate updates according to emerging requirements, and favor an agile software development process (Bernsteiner et al., 2022).

The inclusion of employees who lack computer programming skills in the process of apps and software development aims at exploiting different expertise, such as the ability to define the requirements (Rokis & Kirikova, 2022) and support the application creation according to customers' needs (Yan, 2021; Alsaadi et al., 2021). Indeed, these resources have "*logical and abstract thinking*" (Moskal, 2021, p. 54) that allows them to quickly learn how to use LCDPs/NCDPs to create solutions operating through the graphical user interfaces, using the drag-and-drop technique instead of coding. They can "*design and build powerful applications that efficiently scale the work of related departments without writing code*" (Hyun, 2019, p. 189) and focus more on "*designing the aesthetics and functionality of the application*" (Waszkowski, 2019, p. 376).

Moreover, as previously underlined, the majority of research on LCDPs/NCDPs focuses on their technical aspects, neglecting others (Bernsteiner et al., 2022; Prinz et al., 2021). Therefore, the lack of knowledge about the impact of LCDPs/NCDPs

implementation on specific social aspects has encouraged the author to explore further their impact on business experts and IT professionals' cooperation in different business realities.

### **3. Methodology**

#### ***3.1. Qualitative research and Case-based research strategy***

The topic's novelty encourages a deeper analysis of the subject by applying a qualitative explorative research approach which "*aims to achieve an in-depth understanding of a situation*" (Cooper & Schindler, 2014, p. 144) through the key informants' point of view (Merriam & Associates, 2002).

The qualitative research approach was developed by adopting a case study strategy, which is appropriate when there is little knowledge about the topic under study (Yin, 2018) and to answer how and why questions (Eisenhardt, 1989; Welch et al., 2011). Indeed, such a strategy helps the researcher to investigate "*a contemporary phenomenon (the "case")*" by going deeper into the analysis when "*the boundaries between phenomenon and context may not be clearly evident*" (Yin, 2018, p. 15). Adopting a case study strategy favors clarifying the context and its complexity and a holistic view of the phenomenon (Creswell & Creswell, 2018).

Moreover, in this study, resorting to a case study strategy has helped the researcher to develop a collaborative relationship with key informants to understand their interpretations and experiences (Cooper & Schindler, 2014) about the adoption of NCDPs/LCDPs technologies in two different contexts by enabling comparisons between the cases selected (Yin, 2018).

#### ***3.2. Case selection and data collection***

To achieve the reliability of the data, the author observed the suggestion of Yin (2018) by developing a case study protocol describing the instruments and procedures the researcher should follow. Accordingly, given the aim of the study, the researcher adopted a purposeful sampling technique to identify and select key informants who could provide descriptions of information-rich cases (Palinkas et al., 2015; Patton, 2002). Two companies (Alpha and Beta) were involved in the analysis as part of the research process. They are located in two countries (Italy and Germany) and operate respectively in the software and bank sectors.

Data was collected by developing a semi-structured interview elaborated according to the study's research questions, objectives, and purpose (Saunders et al., 2019; Cooper & Schindler, 2014). It was addressed to key informants (Table 1) reached via e-mail to introduce the research and explain its purpose while asking for interview availability. Four people were interviewed according to their willingness to describe their experience using LCDPs/NCDPs (Palinkas et al., 2015) and collect information about their approach and the changes in collaborations between IT and business experts. In company Alpha, the key informants have different backgrounds in IT and business areas. In contrast, in company Beta, the author had the opportunity to interact directly with the head of the IT department, who is responsible for the digitalization of the company's processes and business model by directly managing the team of developers.

The interviews were conducted virtually through Microsoft Teams in English and Italian, and the purpose of the study was verbally repeated before starting the interview session. They lasted approximately 60 minutes to be completed and were recorded,

transcribed, and integrated with secondary data sources (e.g., reports on the companies' websites, other documents gathered from the internet, and private documents provided by informants) to respect the data triangulation principle (Yin, 2018). In addition, based on key informants' requests, their profiles and those of their companies were anonymized by excluding any possible identifying information.

Table 1 – Interviewees' profiles

Key Informants	Education	Role inside the company	Expertise	Interview duration
1° company Alpha	Management Engineer	Business Process Analyst	Collecting functional requirements to address specific customer needs and digitization projects consulting;	Approx. 60 minutes
2° company Alpha	Computer Scientist	System Architect	Software development; monitoring the job order throughout its life cycle; process analysis from the technology side rather than the information flow side.	
3° company Alpha	Degree in Economics	Business Process Analyst	Analysis of organizational structures and business processes.	
1° company Beta	Computer Scientist	Responsible for the processes' digitalization	Digitalization of processes and company's business model. Managing teams of developers or app development projects.	Approx. 60 minutes

Source: author's elaboration

Moreover, to collect relevant data, it was decided to support the semi-structured interview with the card-based game method (Conrad & Tucker, 2019; Rowley et al., 2012; Jones & Rowley, 2012). Such a method consists of creating game cards with concepts written on them and asking questions during interviews with key informants. According to the informants' interpretation, the game aims to clarify the concepts' importance, prioritization, and possible relationships between them (Rowley et al., 2012). Cards' adoption encourages active participation and facilitates an in-depth gathering about proposed aspects around a topic (Conrad & Tucker, 2019). This research used the card-based game method to gather in-depth information concerning LCDPs/NCDPs, understand the users' reasons and intentions for using them, and their importance in favoring the cooperation between IT and business experts.

Several concepts around the LCDPs/NCDP topic were identified to implement this method. The concepts were selected by considering the literature review on the topic conducted in the previous paragraph (see paragraph 2). However, to refine the concepts on cards and better understand the LCDPs/NCDPs functioning, the author interviewed an LCDP/NCDP platform provider to reinforce the knowledge acquired and better understand the characteristics of these platforms. According to the above procedure, twelve LCDPs/NCDPs critical aspects were identified, such as process automation, time-to-market, no technical skills, decreased costs, cross-platform functionality, vendor lock-in, customization, integration with other tools already adopted, easy changes, better customer experience, faster (digital) transformation, and collaboration between IT and business department (see Table 2).

Table 2 – Cards’ concepts explanation

NCDPS critical aspects	Explanation
Process Automation	Operating the digitalization of business processes.
Time-To-Market	Speed up the app development process thanks to graphical interfaces, not hand-coding.
No Technical Skills	No hand-coding knowledge or IT background is requested.
Decreased Costs	Ability to build more apps in less time, costs decrease, as well as the need for professional developers, reducing/eliminating hiring costs.
Cross-Platform Functionality	Applications can be deployed across a range of devices.
Vendor Lock-In [Platform Providers’ Dependency]	The strict dependency on platforms’ providers (Vendor lock-in) varies from vendor to vendor. It is sometimes complicated for users to maintain an application outside the vendor platform, as the vendor sometimes impedes making App/software changes once the user stops using its platform.
Customization	Customization options vary between platforms. LCDPs generally offer less limited customization than NCDPs, allowing users to customize some aspects of their app/software using hand coding. In contrast, NCDPs do not provide this possibility.
Integration with Other Tools Already Adopted	The easy integration of new apps/software developed with LCDPs/NCDPs with other apps and software adopted by the user.
Easy changes	The quick adaptation of apps/software to suit new requirements facilitates immediate modifications when necessary, according to market changes or customer needs.
Better Customer Experience	The effects of increased speed in innovating business processes and apps deliver favor better customer experience.
Faster Digital Transformation	Removal of complexity from building great, modern business apps/software accelerating the adoption of useful technology.
Collaboration between IT and Business Departments	LCDPs and NCDPs can make everyone in the organization more productive. Accordingly, it can help bring IT and Business departments closer, intensifying dialogue and mutual support.

Source: author’s elaboration

Therefore, twelve cards were developed and adopted to conduct the game (Figure 1) during the semi-structured interview with the key informants.

Figure 1 – Cards adopted during the interviews with key-informants

Time-to-market	Easy changes	Process Automation	Better Customer Experience
Decreased Costs	Vendor Lock-in	No Technical Skills	Integration with Other Tools
Cross-platform Functionality	Customization	Faster Digital Transformation	Collaboration between IT and the Business Departments

Source: author’s elaboration

### 3.3. Data analysis

Before starting the data analysis, the two case stories were written, and each case study report was shared with the interviewees to confirm the accuracy of the information and proceed with data analysis (Ghauri, 2004).

After the interviewees confirmed data accuracy, the author started data analysis by reading each case as a single case and coding the content to provide a first idea of relevant aspects to consider. At the same time, potentially irrelevant aspects were highlighted to be removed after the cross-case analysis, which was made to identify similarities and differences between the two cases (Eisenhardt, 1989) and remove the irrelevant aspects.

## 4. Companies’ profile short description

### 4.1. Alpha

Company Alpha is a cooperative society founded in 2006, counting ten employees and several external collaborations with freelancers.

Since 2017 it has become a private research center whose primary purpose is to carry out industrial research or experimental development activities independently, disseminating the results through teaching, publication, or knowledge transfer activities.

The company was born within a university’s ecosystem in Southern Italy. It represents the result of the combination of different academic and work experiences of a group of researchers who decided to develop their business outside the university by exploiting the know-how acquired. Indeed, they integrated skills and knowledge in heterogeneous fields to offer high-value-added services to public and private actors nationally and internationally.

The company’s expertise mainly concerns business process analysis, ranging from fundraising, including the identification of possible subsidized finance products, to research projects promoted by the Ministry of Economic Development, but also supply and software engineering.

#### **4.1. Beta**

Company Beta was founded in 1825 as an independent savings bank willing to create value for clients. The company counts approximately 1,100 employees, providing its 400,000 private customers with financial and consulting services on asset management, retirement, and real estate matters. It strongly supports approximately 25,000 small and medium-sized enterprises in their growth, focusing on its clients to constantly reinforce the existing relationship. Accordingly, the customers' preferences expressed to the company represent an important non-financial performance indicator that collocated the company as a leader in the relationships with corporate customers if compared to other competitors.

In 2019, the company transformed its hierarchical organization into a network organization to continue providing customer benefits in an environment affected by digitalization and intensive competition.

Moreover, in 2020, the company moved its head office inside a university campus, developing interdisciplinary cooperation and eliminating teamwork boundaries between departments. In addition, according to future strategic measures, Beta is implementing new interventions aiming at the comprehensive digitalization of processes, products, and services to adapt to customers' requirement changes.

### **5. Evidence from the case study analysis**

#### **5.1. Speeding Process Automation and Applications Development**

The key informants of both companies underlined the importance of digitalization according to their customers' needs. However, the increasing volatility of the environment and customers' requests put more pressure on them to accelerate the introduction of digital tools that could facilitate communication with customers and colleagues, reducing the effort to reach valuable results. The customers' requests frequently change according to the pervasiveness of digitalization. Such a situation requires flexibility and the ability of companies to make changes easily according to new requirements.

Both companies opted for implementing an NCDP according to the respective necessities and due to the idea of having tools that facilitate changes in the solutions' development process by allowing its speediness compared to traditional approaches and reduction of costs of the process and projects' management.

Company Alpha adopted an NCDP to have a flexible and fast enough tool to show results to customers immediately. The starting point for evaluating the NCDP as a valuable tool was an order that started simply as a process analysis and required the creation of mock-ups. The team identified several critical issues that could be solved by adopting a Business Process Management Suite (BPMS). However, before providing a specific solution, the company evaluated different technologies and identified an Italian platform as the best solution in terms of functionality and speed of development. The speediness offered by this platform represented the main reason to implement it in the process. The adopted NCDP favors the creation of Business Process Management Cloud Applications within a short time by meeting the customers' needs, going quickly into the development process, and skipping the design process.

With respect to company Beta, the clear strategy based on the digitalization of the company's business model triggered the research of tools helping the complete automation of processes and the development of solutions that could be quickly deliverable to

customers. It aimed at reducing the time and costs associated with the regular manual management of several activities. To do this, the company needed to set up the correct environment, as it lacked an integrated system to channel the flow of information. Indeed, in the period in which the interview was conducted, the employees still had to insert data from excel files into the central system manually. To speed up process automation and digitalization, the company has started automating its processes by adopting the “Microsoft Power Automate” platform, which enables users to build low-code/no-code workflows to automate applications with Robotic Process Automation (RPA). Such a tool allows the company to create and manage automated workflows through a guided experience and to develop chatbots to perform routine tasks efficiently, managing several processes to settle customers’ requests satisfactorily on a case-by-case basis.

### ***5.2. Autonomous Training and Platform Providers’ Support***

As some of the interviewees underlined, *“to become a software developer is a very long journey. You need experience! It is very complicated”*. On the contrary, adopting an NCDP allows process automation and application development without having software developers inside the teams, contrasting these professionals’ lack of availability. NCDPs were described as *“easy to learn”* platforms that allow employees to learn how to use them autonomously.

Company Alpha has a strict and direct relationship with the Italian platform provider of the NCDP, which provides constant support. In general, the platform provider shares frequent updates with the company about the product by including the extension of the NCDP’s potential to guarantee its usefulness according to customers’ new necessities. Moreover, the platform provider supports the learning activity of its users by providing a series of technical documents and training courses with videos lasting a few hours, which give access to the main functionalities of the NCDP. Such support allows them to understand better how to develop a complete solution in just a few days. In addition, the company has the opportunity to ask for consultancy on the application’s various functionalities and additional training sessions to solve specific problems the employees meet while using the platforms (e.g., errors or bugs). It can also resort to dedicated professionals who train its employees about the more complex functionalities of the platform according to the company’s needs.

Considering the experience of Beta with Microsoft, the company allows employees to train with the Power Automate platform through the supporting programs offered by Microsoft-certified partners that started introducing the topic with several workshops. Moreover, by adopting such a tool, the company wants to completely transform its business model from the typical On-Prem into the Microsoft Azure Cloud. Therefore, adopting the Microsoft Power Suite, which includes Power BI, Power Automate, and Power Apps, represented a real advantage for the company. As described by the interviewee, *“we decided to use it [Microsoft Power Suite] because it has a very good licensing model. I think it is very easy to scale, and it provides many services such as monitoring the process, application lifecycle management, version control, and so on”*.

### **5.3. Empowering Business users and collaboration between departments**

The possibility of accelerating the development process by including unskilled IT team members, making them active contributors to the digitalization of operations, was essential for both companies.

In company Alpha, the NCDP implementation enabled more significant involvement of business experts in activities usually delegated to the IT experts, fostering greater collaboration. Indeed, generally, the company's consultants collected all the information *"and poured it over to the [IT] development team."* Thus, there was unidirectionality from the standpoint of knowledge and requirements. Then the IT development team then reported back to the consultant what had been done, asking to verify if the requirements were correctly translated into functionality according to customers' needs. On the contrary, with the adoption of the NCDP, the consultants can autonomously include the requirements inside the platform, making them understandable to the customers that can easily and quickly interact with the solution provided. Therefore, there is no longer unidirectionality as the part of the project run with the NCDP is developed entirely by the consultants, who defer to the IT unit only to create the tailor-made software part. This has fostered bidirectionality by enriching the consultants' knowledge regarding the technological and vertical sphere of IT and, in the opposite direction, fostering greater knowledge of business processes in the IT department. Such an approach favors the *"dispersion of common knowledge, strengthening cooperation between consultants and IT developers."* Involving several non-IT skilled resources in the use of the NCDP favors a more concrete and strict collaboration between IT and business experts. Indeed, employees with a better knowledge of algorithmic and computer-based logic and those with knowledge about business dynamics started a collaboration that favors compensating for each other's limits and sharing knowledge within the company.

Concerning company Beta, the impact of NCDPs brings essential improvements in collaboration between the IT unit and the other departments. First, to proceed with process automation, two people were identified to start working with the platform considered *"very easy to be used to automate any process"* to prepare the ground for implementing a *"citizen developers' strategy."* Indeed, the center of excellence guiding the automation of processes started dialoguing and interviewing employees in different departments to collect ideas concerning potential processes to automate. It started asking them to show their work process, asking, for instance, *"how often they are doing that [work/activity]"* to understand the complexity of the process and organizing dedicated meetings to collect data about repetitive activities. The intent to reduce repetitive manual activities was described as the main company's priority, as they make employees frustrated. Therefore, the center of excellence has started digitalizing processes. Accordingly, encouraging employees to describe processes and activities they consider tedious and repetitive increases the IT unit's understanding of the processes and the possibility of automating them. Such an approach puts the IT department in contact with the other department favoring a deeper dialogue and making employees proactive collaborators.

### **5.4. LCDPs Limits and Potential Resistances**

NCDPs' implementation has been demonstrated to speed up flows' digitalization by making changes more easily than a classical software development solution. Moreover, the

cross-platform functionality of the NCDPs adopted by the two companies allows the applications to be run on multiple devices.

However, as described by company Alpha, the most critical part of implementing the NCDP has been the difficulty in integrating it with tailor-made software developed with traditional technologies. In that case, the initial difficulty was obtaining a common language for both software, which used different programming languages. In addition, the customization of solutions according to specific client's requests is not allowed by using an NCDP, representing a limitation compared to traditional development technologies. As one of the interviewees of company Alpha said, *"With this technology [NCDPs], sometimes we had constraints because the set of interfaces is limited anyway, precisely because the interaction buttons are limited."*

Furthermore, in company Alpha, *"the resistance is something that cannot exist"* as it has never faced any negative experience. As the interviewees underlined, *"those who have vertical skills, which means knowledge of computer systems and programming languages, may disagree with using this modality."* However, no concrete technical barriers exist to adopting the NCDP or real opposition.

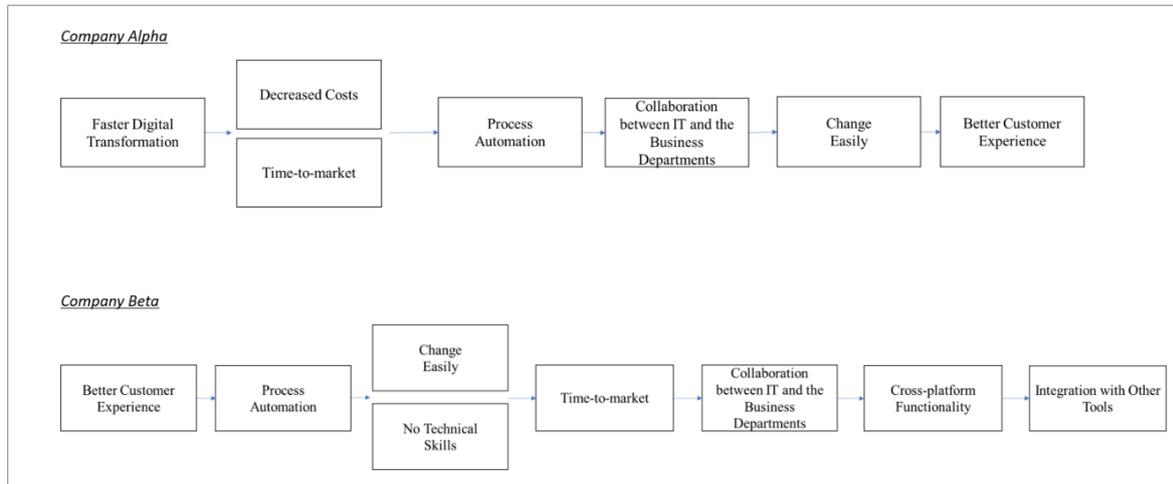
In company Beta, the company's idea was to start making employees able to automate processes by themselves and develop chatbots. Therefore, the center of excellence started automating some processes and creating chatbots, intending to involve in this activity other employees very soon. However, the automation of processes and chatbots' adoption made some employees afraid of losing their work *"because it [chatbots] can do their work, maybe by 100%"*, but this way of thinking did not represent a concrete resistance experienced by the company at the moment of the interview.

## 6. Discussion of findings

Low-code and No-code technology allowed companies to make changes more easily and quickly than a classical software development solution. The frequent changes in customer requests that guide the companies' orientation can be challenging to manage without flexibility. Adopting digital tools that help make changes quickly according to new requirements was extremely important for them. Adopting an NCDP made the analyzed companies more likely to develop solutions autonomously and rapidly. Moreover, these solutions were easily integrated with other external tools, thus making them more valuable and particularly suited to companies' business purposes.

Even describing the advantages and critical aspects of NCDPs' by following different storytelling (Figure 2), with the adoption of such strategic tools, the companies aim at accelerating the company's digitalization to offer a better customer experience to their clients. All the aspects described during the interview, also thanks to the application of the card-based game method, are factors linked to customer satisfaction achievement. Indeed, it emerged that NCDPs not only favor facing customers' requests made volatile due to the pervasiveness of digital technologies, but they also ensure the possibility of quickly accessing the required functionalities due to rapid prototyping.

Figure 2 – LCDPS/NCDPS critical aspects described by companies



Source: authors' elaboration on the Card-based game method results

Moreover, involving resources with different backgrounds and expertise in digitalization and application development has been fundamental. In both companies, these platforms have been easily implemented, allowing employees to learn how to use such tools autonomously. Indeed, the interviewees described the adoption of NCDPs as an essential tool to reach the objectives of digitalization, process automation, and employee inclusion. Due to the easiness of learning and using the platform, and the possibility of involving dedicated internal resources in developing solutions, digitalization and process automation goals have been possible even when the company lacks specific IT resources. Involving unskilled IT resources in solution development triggered a series of changes for the two companies, favoring a faster transformation due to the low complexity that characterized these platforms and reducing repetitive activities and their manual management. In addition, including business experts in activities usually delegated to professional developers encouraged deeper communication and collaboration among employees, favoring knowledge contamination. Indeed, business consultants and IT professionals started collaborating according to the idea of speeding up process automation. Business experts support clear workflow descriptions and learn how to use the NCDP to support application development, eliminating departmental boundaries. This has also reduced dependence on professional software developers hired as external collaborators and the efforts of internal ones used to develop software and applications entirely with traditional hand-coding methods.

In addition, automating processes with less effort than traditional technologies and developing software and applications in a few weeks has made companies and employees more flexible thanks to the automation of services via workflow, thereby reducing the time and costs associated with their manual management. The NCDPs have also decreased costs and implemented quicker application development and process automation by reducing the time and effort on a single project.

## 7. Theoretical and Managerial Implications.

The analysis of the outcomes suggests some theoretical and managerial implications. From the theoretical point of view, the study contributes to the managerial literature by confirming the importance of low-code technologies, with specific reference to NCDPs as tools that support companies' process automation and digital transformation. Moreover, according to the study's objectives, it has been possible to contribute to analyzing the impact of NCDPs implementation regarding social aspects. Indeed, they represent inclusive tools that allow companies to implement a citizen developer strategy. Such strategy is sometimes a goal that the companies set up at a certain point in their lives to start a transformation that can help them to maintain their competitiveness and respond to context changes. Other times, it is a step to make departments/units inside a company closer to developing projects and improving communication. Accordingly, NCDPs favor the involvement of resources with different skills in the process of solutions' creation representing tools that encourage cooperation and a stimulus for knowledge contamination. Therefore, the results of this study contribute to the literature dedicated to the impact of No-code technologies on social aspects related to the work of human resources employed in the firms.

From the managerial point of view, the article's evidence shows the importance of these technologies in the cooperation between employees, especially concerning IT and business experts. Such technologies stimulate dialogue between the two units, favoring knowledge contamination. Indeed, these two units generally speak a different language due to the lack of IT knowledge on the business side and the lack of knowledge about business processes on the IT one. By implementing the NCDPs, firms have the opportunity not only to introduce a tool that increases the competitiveness of the firms by facilitating speediness in application and software development but to positively affect the employees' daily activities creating synergies between different roles.

## 8. Conclusion, Limitations and Future Research Suggestions

The analysis contributes to the managerial literature on LCDPs/NCDPs in which the topic is emerging. It also provides a better understanding of the business and IT departments/units' cooperation in companies belonging to different sectors.

Despite the elements of novelty, this article is not free of limitations that can be considered points of departure for further analysis of the topic. The first limitation relates to the focus on a specific social aspect, which gives some hint about the impact on IT and business experts' cooperation changes triggered by NCDPs introduction, without providing a broader contribution due to the limited number of cases involved in the analysis. Indeed, the second limitation concerns the implementation of a qualitative methodology by focusing on a limited number of cases. Implementing a case study strategy based on interviews and the card-game-based method represented an innovative methodology that has never been applied to LCDPs/NCDPs adoption studies. This methodology has been instrumental in identifying the most critical aspects of the phenomenon according to the key informants' points of view. In addition, the rigor in developing (and describing) the detailed procedure for implementing the case-study strategy has favored data collection transparency and interpretation. However, the limited number of cases involved in the analysis does not favor the generalization of results.

Building on the limitations of this article, future researchers should extend the analysis of LCDPs and NCDPs' impact from a social point of view, considering benefits and clarifying criticalities in their implementation. Moreover, developing a case study strategy should be supported by incrementing the number of cases and integrating with a mixed-method approach to increase the possibility of the results' generalization.

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## References

1. Alsaadi, H. A., Radain, D. T., Alzahrani, M. M., Alshammari, W. F., Alahmadi, D. & Fakieh, B. (2021). Factors that affect the utilisation of low-code development platforms: survey study. *Romanian Journal of Information Technology and Automatic Control*, 31(3), 123-140.
2. Beranic, T., Rek, P., & Heričko, M. (2020). Adoption and usability of low-code/no-code development tools, *Proceedings of the Central European Conference on Information and Intelligent Systems*, 97-103.
3. Bernsteiner, R., Schlögl, S., Ploder, C., Dilger T. & Brecher, F. (2022). Citizen vs. Professional Developers: Differences and Similarities of Skills and Training Requirements for Low Code Development Platforms. *Iceri2022 Proceedings*, 4257-4264.
4. Chandran L. C., & Abdulla, M. S. (2022). A survey of Low-Code/No-Code software development tools with an application. Working Paper, IIMK/WPS/524/ITS/2022/08. Retrieved from [https://iimk.ac.in/uploads/publications/IIMK\\_WPS524ITS\\_2022\\_08Upload\\_File.pdf](https://iimk.ac.in/uploads/publications/IIMK_WPS524ITS_2022_08Upload_File.pdf)
5. Conrad, L.Y. & Tucker, V.M. (2019). Making it tangible: hybrid card sorting within qualitative interviews. *Journal of Documentation*, 75(2), 397-416.
6. Cooper, D. R., & Schindler, P. S. (2014). *Business research methods*. Twelfth edition. New York, NY: McGraw-Hill/Irwin - series in operations and decision sciences business statistics.
7. Creswell, J. W. & Creswell, J. D. (2018). *Research Design. Qualitative, Quantitative, and Mixed Methods Approaches*. USA: SAGE.
8. Eisenhardt, K. M. (1989). Building Theories from Case Study Research. *The Academy of Management Review*, 14(4), 532–550.
9. Ghauri, P. (2004). Designing and conducting case studies in international business research. In Marchan-Piekkari, R. & Welch, C. (Eds.), *Handbook of Qualitative Research. Methods for International Business* (pp. 109-124). UK, Edward Elgar.
10. Hyun, C. Y. (2019). Design and Implementation of a Low-Code/No-Code System. *International Journal of Advanced Smart Convergence*, 8(4), 188–193.
11. Ihirwe, F., Di Ruscio, D., Mazzini, S., Pierini, P., & Pierantonio, A. (2020). Low-code engineering for internet of things: a state of research, *Proceedings of the 23rd ACM/IEEE International Conference on Model Driven Engineering Languages and Systems: Companion Proceedings*, 1-8.

12. Jones, R., & Rowley, J. (2012). Card-based game methods: exploring SME entrepreneurial marketing practice. *International Journal of Entrepreneurship and Small Business*, 16(4), 485-502.
13. Khorram, F., Mottu, J. M., & Sunyé, G. (2020). Challenges & opportunities in low-code testing". *Proceedings of the 23rd ACM/IEEE International Conference on Model Driven Engineering Languages and Systems: Companion Proceedings*, 1-10.
14. Lebens, M., Finnegan, R. J., Sorsen, S. C., & Shah, J. (2021). Rise of the citizen developer. *Muma Business Review*, 5, 101-111.
15. Marinković, D., & Avramović, Z. Ž. (2021). Software Platforms Based on the Principles of Graphic Design, Automatic Command Generation and Visual Programming. *Jita-Journal of Information Technology and Applications*, 22(2), 110-115.
16. Merriam, S. B., & Associates. (2002). Introduction to qualitative research. In S. B. Merriam (Ed.), *Qualitative research in practice: Examples for discussion and analysis* (pp. 3- 17). San Francisco, CA: Jossey-Bass
17. Moskal, M. (2021). No-Code Application Development on the Example Of Logotec App Studio Platform. *Informatyka, Automatyka, Pomiary W Gospodarce I Ochronie Środowiska*, 11(1), 54-57.
18. OutSystems, (2019). The State of Application Development: Is IT Ready for Disruption? [www.outsystems.com](http://www.outsystems.com). Accessed 04 January 2023.
19. Palinkas, L. A., Horwitz, S. M., Green, C. A., Wisdom, J. P., Duan, N., & Hoagwood, K. (2015). Purposeful sampling for qualitative data collection and analysis in mixed method implementation research. *Administration and policy in mental health and mental health services research*, 42(5), 533-544.
20. Patton, M. Q. (2002). *Qualitative research and evaluation methods*. Thousand Oaks, CA: Sage.
21. Prinz, N.; Rentrop, C. & Huber, M. (2021). Low-Code Development Platforms – A Literature Review, *27th Americas Conference on Information Systems (AMCIS) Proceedings*, 2, Montreal.
22. Richardson, C. & Rymer, J. R. (2014). *New Development Platforms Emerge for Customer-Facing Applications*. Retrieved from [www.forrester.com](http://www.forrester.com).
23. Rokis, K., & Kirikova, M. (2022). Challenges of Low-Code/No-Code Software Development: A Literature Review. In: Nazaruka, Ę., Sandkuhl, K., Seigerroth, U. (eds) *Perspectives in Business Informatics Research, Lecture Notes in Business Information Processing*, 462. Springer, Cham.
24. Rowley, J., Jones, R., Vassiliou, M., & Hanna, S. (2012). Using Card-Based Games to Enhance the Value of Semi-Structured Interviews. *International Journal of Market Research*, 54(1), 93–110.
25. Rymer, J. R. (2017). The Forrester Wave™: Low-Code Development Platforms For AD&D Pros, Q4 2017 n. October 12. Retrieved from <https://go.forrester.com/>.
26. Sanchis, R., García-Perales, Ó., Fraile, F. & Poler, R. (2020). Low-Code as Enabler of Digital Transformation in Manufacturing Industry, *Applied Sciences*, 10(1), 1-17.
27. Saunders, M. N. K., Lewis, P. & Thornhill, A. (2019). *Research Methods for Business Students*. New York: Pearson.
28. Silva, C., Vieira, J., Campos, J. C., Couto, R., & Ribeiro, A. N. (2021). Development and Validation of a Descriptive Cognitive Model for Predicting Usability Issues in a Low-Code Development Platform. *Human Factors*, 63(6), 1012–1032.
29. Suri, H. (2011). Purposeful sampling in qualitative research synthesis, *Qualitative Research Journal*, 11(2), 63-75.

30. Vincent, P., Iijima, K., Driver, M., Wong, J., & Natis, Y. (2019). Magic Quadrant for Enterprise Low-Code Application Platforms. Retrieved from [www.gartner.com](http://www.gartner.com).
31. Waszkowski, R. (2019). Low-code platform for automating business processes in manufacturing, *IFAC-PapersOnLine*, 52(10), 376-381.
32. Welch, C., Piekkari, R., Plakoyiannaki, E., & Paavilainen-Mäntymäki, E. (2011). Theorising from case studies: towards a pluralist future for international business research. *Journal of International Business Studies*, 42(5), 740–762.
33. Wong, J., Driver, M., & Vincent, P. (2019). Low-code development technologies evaluation guide. Retrieved from <https://www.gartner.com/en/documents/3902331>.
34. Yan, Z. (2021). The Impacts of Low/No-Code Development on Digital Transformation and Software Development. Retrieved from <https://arxiv.org/abs/2112.14073>.
35. Yin, R. K. (2018). *Case Study Research and Applications. Design and Methods*. Los Angeles: Sage Publications.