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Democratising Software and Applications Development: A Multiple Case Study

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Abstract

Purpose: By following Davis' technology acceptance model (1989), the authors investigate the factors affecting the adoption of graphic user interface (GUI) oriented technologies able to democratise software and applications development for various business purposes as alternatives to customised software processes from the users' perspective.
Methodology: We developed a multiple-case study by collecting primary data through semi-structured interviews with key informants from three Italian companies adopting GUI-oriented technologies. We triangulated data by analysing secondary sources such as internal reports, online articles and social networks (e.g., LinkedIn) and developed a content analysis using NVIVO software.
Findings: The content analysis shows that users link the utility of GUI-oriented technologies with their need for a flexible and fast enough tool to create solutions and demonstrate to customers results almost immediately by considerably shortening the time-to-market, mapping and building business processes rapidly. Moreover, the technologies' user-friendliness is associated with the possibility of autonomous training, the development of applications with a relatively limited level of technological knowledge by prioritising requirements over details, and easy integration with other external elements. However, some cultural and non-technical barriers and resistances to technology adoption were mentioned.
Research limitations/implications: The paper presents some limitations, mainly regarding the sample size. Concerning implications, the first concerns managers' ability to evaluate the GUI-oriented technology features by matching them with the company's needs for maximising its digital impact. The second one regards the managers' awareness of GUI-oriented technology in reducing repetitive activities and accelerating the application development and release.
Originality/value: Compared to past studies, which mainly focused on testing the consistency of the model, this study adopted the TAM perspective to identify the main antecedents of adopting an unexplored GUI-oriented technology.

Keywords: GUI-oriented technologies; LCDPs; TAM; Multiple case study.

Paper Type: Research paper

1. Introduction

This working-in-progress research aims to investigate the factors affecting the adoption of graphic user interface GUI-oriented technologies able to democratise software and applications development for various business purposes as alternatives to customised software processes from the users' perspective by following Davis' technology acceptance model (1989).

GUI-oriented technologies facilitate companies' approach to technology by diminishing problems and risks related to traditional technology's adoption. The research remains an under-investigated and unexplored topic (Khorram et al., 2020; Sanchis et al., 2020). Accordingly, this study aims to understand the importance of these technologies in the Digital Transformation process and the main variables of their' adoption from users' points of view. More in detail, by adopting a TAM perspective, the intent is to explore and understand the factors that encourage the adoption of GUI-oriented technologies and provide information about users' behaviours while using them.

The paper is structured as follows. In the research background, we contextualise the main research and debates about GUI-oriented technologies' adoption. The methodology section introduces our research method, including sampling techniques and content analysis tools. Then, the main findings of the qualitative research are indicated. In the discussion, we comment on the main points regarding our research, and the conclusion section highlights reflections on the research and future research.

2. Research Background

Technology adoption is one of the most critical challenges for companies due to the difficulties of its implementation. For this reason, information technologies (IT) applications are increasingly user-friendly through graphic user interfaces (GUIs) designed to significantly improve the functionality of the system by enhancing the ease of use (Wu et al., 2006).

Low-code and No-code technologies are specific GUI-oriented technologies that allow people to produce customised applications without requiring IT programming skills. They considerably impact how companies react to technology implementation, especially from the adoption perspective.

A consistent framework to predict the adoption and use of new technology is the Technology Acceptance Model (TAM) (Davis, 1989) which *"postulates that the acceptance of technology is predicted by the users' behavioral intention, which is, in turn, determined by the perception of technology usefulness in performing the task and perceived ease of its use"* (Marikyan & Papagiannidis, 2022, pag. 79). Moreover, the perception of usefulness and ease of use of technology is also influenced by external variables (e.g., social influences and facilitating conditions) (Portz et al., 2019). In addition, users' attitudes toward the technology are the principal determinant of whether they will use or reject it.

Low-code and No-code development platforms (LCDPs and NCDPs) represent a GUI software category (Bock & Frank, 2021) that is gaining attention due to the opportunity they offer to create web and mobile applications using pre-built visual design tools (Gardner, 2021; Woo, 2020; Khorram et al., 2020; Rymer, 2017). They empower citizen developers to refine and scale entrepreneurial opportunities (Dushnitsky & Stroube, 2021), supporting companies' transformation (Missikoff, 2020). Indeed, their implementation is generally related to the absence of professional developers but also to the need for process automation, cross-platform accessibility and app integration (Talesra & Nagaraja, 2021; Sahay et al., 2020; Metrôlho et al., 2020). Such technologies accelerate the applications development process lowering its costs (Schötteler et al., 2021; Marinković & Avramović, 2021; Beranic et al., 2020), reducing the risk connected to traditional software development, prioritising apps' critical steps (e.g., configuration and training) and reducing repetitive and time-consuming activities (Waszkowski, 2019). Moreover, they favour the dialogue and the interoperability between the business and IT departments (Farshidi et al., 2021) and the non-technical departments in the app development process (Beranic et al., 2020).

Although the TAM has been investigated extensively both in terms of technology types and

adopting industries (Park et al., 2018; Chin & Lin, 2015; Holden & Karsh, 2010), to the best of the authors' knowledge, its application in GUI-based technologies, such as LCDPs and NCDPs is scarce, with only a few studies that dealt with the topic (i.e. Ploder et al., 2019 and Opitz et al., 2012).

According to the lack of studies on LCDPs and NCDPs' implementation (Khorram et al., 2020; Sanchis et al., 2020), this research aims to understand the main variables of LCDPs and NCDPs' adoption, and more in detail, to explore and understand the critical determinants and the related employees' acceptance behaviours while using such platforms. Therefore, our research question is: *What are the main antecedents of LCDPs' adoption?* From now on and throughout the paper, the "LCDPs" label is adopted to indicate both LCDPs and NCDPs due to the irrelevance of the technical differences for the analysis we are conducting, as they can be both considered platforms that allow users to simplify the process of app creation by resorting to minimal or no coding.

The methodology adopted to answer the research question and reach the study's goals is described in the next paragraph.

3. Methodology

We developed a multiple-case study (Yin, 2018) to capture the overall robustness of results and keep the richness and complex details of the phenomenon under investigation (Lindgreen et al., 2021). Indeed, the paper aims to explore and understand (Blaikie, 2000) the impact of GUI-oriented technologies (i.e., LCDPs) on the digital transformation process with a particular interest in identifying the main variables related to its adoption from the user's point of view.

To develop the analysis, we selected three companies operating in different sectors (Table 1). We collected data from different sources to guarantee the reliability of the case study development process and ensure data triangulation (Yin, 2018). Primary data were collected through a semi-structured interview specifically designed to link the research questions to the objectives of the analysis (Yeong et al., 2018; Castillo-Montoya, 2016), while secondary sources refer to internal reports and documents provided by the interviewees and articles and papers retrieved online and on companies' websites and professional social networks.

Table 1 - Companies' characteristics

Company	Number of employees	Sector	Core business
Company Alfa	60	Services	IT Services; e-payments
Company Beta	20	Management Consulting	Executive Consulting
Company Gamma	10	Research & Development and Consulting	Industrial Research and Experimental Development

Source: authors elaboration

To maintain flexibility in data capturing and adapt questions according to the flow of the conversation (Saunders et al., 2009), increasing the possibility of collecting high-quality data, the development of the interview questions followed a structured protocol (Castillo-Montoya, 2016). They have been aligned to the research questions through the constant confrontation between the researchers by allowing the collection of specific comments making the interview more consistent. To increase the information power of our data, we selected a sample of interviewees (Campbell et al., 2020) through the purposive sampling strategy. More in detail, according to the theoretical setting of

the research and the suggestions of the agile consultants, we identified a specific and relevant sample with adequate information power (Malterud et al., 2016), composed of five key informants. The specificity of the sample reflects the interviewees' roles and experience on the topic investigated, characterised by the following requirements:

- first, interviewees should have specific knowledge and expertise on LCDPs' implementation within their companies. This requirement allowed us to interact with people formally involved and aware of these technologies;
- second, interviewees should be in charge of teams or companies to provide a consistent and overall overview of the phenomenon under investigation.

These criteria assured us of a detailed description of the relevant aspects of our research aim by relying on good informants who provided us with the most important information and direct knowledge of the investigated phenomena (Yin, 2018).

The interviews were recorded and audio-taped to facilitate the notetaking and the following transcription. The authors created single reports for each case analysed and sent them to the interviewees for a validity check by favouring the collection of new details, assuring the validity of the results.

We analysed the interview transcripts after each round of interviews to proceed with the theoretical samplings. Moreover, the opportunity to contact participants after interviews to clarify some aspects contributed to refining theoretical concepts, thus forming part of theoretical sampling.

More in detail, data analysis was conducted using the NVivo computer-assisted tool for qualitative data. Data coding was carried out separately for each source of data collected by two authors and then discussed among the researchers. We developed our coding systems individually and through team meetings and discussions. All researchers supported analysis activities, and regular meetings were convened to discuss and contextualise emerging interpretations, introducing a wide range of content perspectives.

4. Multiple-case study evidence

4.1. Utility of GUI-oriented technologies

The reasons that led the companies to adopt LCDPs technologies have been linked to several aspects, such as (1) the need to map and build internal processes quickly, structuring them and, more importantly, making them understandable and manageable for all the employees (Alpha). Indeed, as described by the interviewee of Alpha, the possibility *"to quickly map and build applications that allow having a much broader and more intense exchange and transparency of data within the company departments"* represents an essential aspect of building the company's structure. Similarly, in company Gamma, cooperation has created the conditions for sharing knowledge and making employees communicate.

Other aspects are represented by (2) the need to develop software projects that allow the easy integration of applications already used by the company acquiring a certain level of flexibility without asking for much knowledge to conduct the process (Beta), and (3) the need to have a tool that was flexible enough to create mock-ups quickly as well as to manage the follow-up processes on orders starting from the process analysis (Gamma).

Accordingly, the utility of such technologies is represented by the possibility for the companies to satisfy their internal needs and customers' requests. The speed of solutions' implementation is undoubtedly one of the significant advantages mentioned. Indeed, the greatest strength of GUI-oriented technologies and, more specifically LCDPs is that they make it possible *"to obtain solutions by handling an application system without actually knowing what the languages might be and thus being able to obtain valuable results despite not having a purely IT background"*

(Gamma).

Furthermore, such technologies allow a product with a set of capabilities, thus facilitating and *"accelerating the prototyping"*, enabling the quick realise. Such an aspect is crucial, especially in interacting with agile customers, as it favours the creation of solutions' drafts in an extremely short amount of time. Indeed, to *"develop something very quickly in an iterative manner, even with a rather bizarre and unattractive appearance"* highly reduced the risk of making mistakes (Beta) and develop something much more efficient and responsive to the needs expressed by clients. Accordingly, LCDPs tools allow the company to iteratively model the behaviour of an application while interacting with customers/users who know the business processes very well and the final result that should be reached by *"considerably shortening the time-to-market"* (Alpha, Beta and Gamma).

LCDPs allow users to create applications in at least three/four weeks instead of five/six months, as generally happens by adopting traditional methodologies, by *"prioritising requirements over details"* (Beta). Moreover, they give the possibility of developing applications that can be run on smartphones and the web (Alpha, Beta and Gamma), starting with *"a core set of basic functionalities that can be extended and tailored according to customer's needs"*. Indeed, generally, *"customers hardly express requirements";* thus, the possibility to modify in a short amount of time the solution created represents an important aspect (Beta). In addition, reusing portions of applications to create new ones and integrating applications already adopted with external elements, making them communicate with each other, facilitate the efficiency of processes (Alpha, Beta and Gamma).

4.2. Technologies' user-friendliness

As described by the interviewees, the learning curve of LCDPs is shorter than traditional software, and it is easier for non-programmers to use them once they understand their logic. Therefore, the user-friendliness aspect of such technologies is mainly linked to the possibility of autonomous training and usage by single users. Indeed, as underlined by the interviewees of company Gamma, *"the initial training can certainly be done independently"* by consulting the technical documentation, which is well drafted and complete. In addition, the constant support of the platform provider in each step, from training to the development and implementation of solutions, enables LCDPs' adoption (Alpha and Gamma).

Moreover, the possibility to exploit several resources that do not have IT skills and experience in traditional programming represents a significant advantage for all companies. Users have the possibility to gradually validate the idea, improving it without requiring programmers to intervene. The simplicity of managing these applications is fundamental for those who adopt them, mainly with the idea *"to put this platform in the hands of people who have never approached language programs"* (Alpha). The company Alpha and Gamma's idea involved the different resources in building and managing the new processes, including the human resources department. Such an approach made possible an unprecedented collaboration between business and IT departments/units and with all the other units of the two companies. Concerning company Alpha, the interviewee highlighted that *"these technologies allowed to reduce the gap between the two departments* (business and IT department) *and, at the same time, the IT department has been relieved of a series of tasks, for instance, the deployment phases of applications".*

Similarly, the importance of developing something with limited technological knowledge and integrating other things outside the system the user is developing is extremely useful. As described by the interviewee of company Beta: *"Once I have drawn up where things are and what relationships there are between them, the rest of the development is to take standard human-computer interaction components and attach them together within a navigation chain, which is then what leads the user actually to have the buttons on the web. At this point, all I have to do is compose the page that I'm going to use to show and make the user interact"*. In this process, the users do not model the solutions' aesthetics, but rather, they are modelling the functionalities *"without writing a single line of code"* by immediately visualising the behaviour of the solution developed. Therefore, the expertise in the case of company Beta is more in the process analysis than in the technical aspect of the tool.

In addition, the possibility to reuse everything that has been developed by using such

technologies makes it easier to develop new solutions than the traditional approach, which requires more technical skills.

4.3. LCDPs' implementation criticalities

Although the importance of these technologies for the companies involved in this study, they also listed several weaknesses/criticalities. First, the strong dependence on the platform provider that supplies the technology. Indeed, as described by the interviewee of company Alpha *"compared to traditional development products, the company (platform provider) must always guarantee that the service remains in place and therefore still allow me to work with these products,"* representing a high risk for users. Second, sometimes integrating LCDPs' solutions with other applications and tools already adopted requires more structured skills, which are more likely those of a programmer. Indeed, for those who manage the integration with other systems, *"it's preferable to know a little programming, a little flowcharting, a little logic" (Alpha)*. In addition, the different languages adopted by LCDPs, and other computer scripting languages are sometimes difficult to manage. As described by the interviewee of company Gamma, on some occasions, "*to manage to achieve a common language between that of low-code technologies and the one used by other applications such as the Python language ask for more efforts".*

Third, according to the interviewee of company Beta, although the advantages of involving un-skilled resources in the process of applications and solutions development, if a company want to exploit the real benefits of working with LCDPs, it should identify three types of professionals to involve, which are represented by the technician, the architect and the analyst. As described, the company *"need someone who knows how to make the best use of the tool to get things efficient, beautiful, even aesthetically so that we have an attractive and easy-to-use User Experience ...[...]...and the architect who knows exactly where to put things, how to size the servers and to balance the costs with scalability and processing speed requirement, but above all, the analyst who looks at the customer's needs and model within the tool at a fairly high level of abstraction, which then allows you to reuse perhaps components already developed to do other things"*.

Finally, as described by one of the interviewees of company Gamma *"at a certain point, it* (the use of LCDPs) *can be a limit to meet customers' needs as they can require tailor-made modifications"*. Indeed, these platforms do not allow customisation, which requires the usage of hand-coding languages.

4.4. Barriers and Resistances to technology adoption

The interviewees mentioned non-technical barriers and resistance to LCDPs' adoption. Concerning barriers, these are mainly related to cultural approaches, and while in some cases they are minimal, in others they are completely absent. Indeed, introducing LCDPs inside company Alpha represented a good step for the company and something important for improving all the employees' activities. Similarly, in company Gamma, minimal barriers were described and mainly connected with the importance of *"knowing the very logic of writing a solution",* and that can be avoided with the efficient training processes enabled by documentation and courses provided by platform providers.

In the case of company Beta, the barriers described were mainly cultural barriers. The aspect mentioned was the capability to change the approach adopted by working with these technologies, which mainly resulted in understanding how to manage the information to get the right data model.

With specific reference to resistance to technology adoption, only companies Alpha and Beta experienced it. Company Alpha experienced some initial resistance from *"the administrative department that was used to manage processes in an unstructured way. There was no criticism related to the LCDPs but more related to how we set up and mapped the process within the product"*. In addition, the interviewee also explained that the development department was initially against LCDPs adoption because "*they would have developed these applications with traditional languages"*. However, the possibility to develop applications within three weeks, while "*with a traditional*

approach, it might have taken four to five months", led them to change their point of view understanding the importance of the tool for the company.

Instead, the interviewee of company Beta admitted that even he was against LCDPs' adoption at the beginning because he would have preferred to use other (traditional) technologies. The resistance was related to the aesthetical final result of the application that, at the time, was not appreciated due to its minimal design. However, he realised that his point of view was wrong and as the functionalities of the LCDP platform adopted increased, *"that kind of issue has been overcome".*

5. Discussion and Conclusions

As described in the previous paragraphs, the results of the multiple case study conducted by developing a content analysis using NVIVO software show that users link the utility of GUI-oriented technologies with their need for a flexible and fast enough tool to create solutions and demonstrate to customers immediate results and by considerably shortening the time-to-market as well as mapping and building business processes rapidly. Accordingly, the platform's flexibility allows it to meet the different needs of final users adopting the solutions developed according to customers' requirements quickly. The possibility of experimenting with such an approach meanwhile interacting with the clients reinforced the willingness to adopt LCDPs. Moreover, the possibility to create apps that can be run on different devices and integrated with other existing applications adopted by the company represents an important aspect that encouraged the implementation of such tools.

Moreover, the technologies' user-friendliness is associated with the possibility of autonomous training, the development of applications with a relatively limited level of technological knowledge by prioritising requirements over details, and easy integration with other external elements. Indeed, having a platform that is constantly improved according to client requests and the evolution of the markets, with the possibility of learning how to use it autonomously through information material and courses, positively affects the experience of adopting it. In addition, the constant support of platform providers through information material and courses and dedicated counselling encouraged their adoption.

Furthermore, developing applications and other solutions without having technical skills represented the most important input that sparked the interest of these companies in these technologies according to their intent to involve several different resources in the development of applications. Meeting these goals has made these companies more efficient in building relationships with their clients, especially with specific reference to agile ones.

The experiences of the companies are also characterised by cultural and non-technical barriers and resistance to technology adoption at the beginning of the LCDPs' implementation. However, barriers and resistances represented something temporary that characterised the beginning of the experiences where the companies introduced such technologies to their employees, impacting the development of their activities. Luckily, the positive impact on processes and application development made employees prone to accept such technologies.

Moreover, despite the positive aspect, there are still criticalities to which companies are still exposed. These are represented by the dependence on the platform provider, which can represent a risk for the company's survival, the integration with other existent solutions and the customisation of applications that are possible only if a user has programming skills.

According to the literature background, the results obtained from this work-in-progress analysis show different original insights. Indeed, the TAM literature has been generally used for testing adoption theories by confirming or disconfirming the consistency of the model (Ros et al., 2015; Jeffrey, 2016) through the analyses of different technologies within different sectors both in Western cultures and others (Schepers & Wetzel, 2006). In the case of the current paper, adopting the TAM perspective and a qualitative approach with the intent of understanding the main antecedents related to the adoption of the under-explored domain of LCDPs allowed us to delve into the topic of discovering the main variables related to using such user-friendly and innovative tool.

In developing the paper, we also had the opportunity to highlight some managerial implications. Indeed, managers should evaluate the GUI-oriented technology features according to

the company's needs for optimising its digital impact. In addition, the managers should be aware of the cost impact of GUI-oriented technology. Indeed, although the limited customisation, its adoption favours the redesign of processes and procedures that reduce repetitive activities, accelerating application development and release.

As the paper is currently a work in progress, it presents some limitations, which mainly reside in the sample size. Indeed, despite we did not aim to generalise the results of our sample statistically, for the analytical generalisation, future research could test the model with more data and confirm or refine the variables elicited.

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