The Future Use of LowCode/NoCode Platforms by Knowledge Workers – An Acceptance Study

Christian Ploder(✉), Reinhard Bernsteiner, Stephan Schlögl, and Christoph Gschliesser

Management Center Innsbruck, Management, Communication & IT, Innsbruck, Austria
{christian.ploder, reinhard.bernsteiner, stephan.schloegl, christoph.gschliesser}@mci.edu

Abstract. Knowledge Workers have to deal with lots of different information systems to support daily work. This assumption leads to massive gaps in companies based on the complexity of legacy systems on one hand side and the development of the business processes on the other hand side. Many knowledge workers build their own shadow IT to get efficient process support without thinking about compliance, security, and scalability. One possible solution to deactivate this situation might be the idea of LowCode/NoCode platforms. The question is: Will knowledge workers be using this technology or are they not accepting the new trend? Therefore, the authors conducted a quantitative study based on an online questionnaire (N = 106) to check the acceptance of this upcoming technology for companies in the DACH region. The result of the study is a statement about the future willingness to use.

Keywords: Knowledge workers · LowCode/NoCode Platform · Process support · Shadow IT

1 Introduction

Most of the current knowledge workers [1] are using information systems especially database systems for lots of their daily tasks to extract information [2]. In the context of this paper knowledge workers are defined by their emphasis on "non-routine" problem-solving tasks that require a combination of convergent and divergent thinking [18] – this is not the case for all IS users in a company. Rarely the governed IT infrastructure can provide all the necessary tools for every preference of the individual working space. Current developments as cloud computing build the technological base for new initiatives like LCNC platforms as a widely opened platform to develop solutions for knowledge workers challenges on their own. - "on their own" means without any development skills.

Current IT landscapes in large companies have restricted budgets to pay for Hard-/Software but also to pay consultancy services in order to design and implement systems [3]. The so-called legacy systems (most of them are of high priority to run the company's

L. Uden et al. (Eds.): KMO 2019, CCIS 1027, pp. 445–454, 2019.
https://doi.org/10.1007/978-3-030-21451-7_38

business like ERP or MES systems) had very long development times, and their modification is very tricky after their initial implementation. While legacy systems expand beyond the original purpose in order to maintain new or changing business requirements, the implementation of new features is very cost intensive. Professional developers need to develop the new code and implement it to a very complex system. Apart from professional IT department lots of employees and entire departments, use their solutions based on MS Excel or MS Access in order to close the gap between existing information systems and their daily business processes. This behavior is called "shadow IT" and bears several risks on security, manageability, and compliance. The good thing about self-developed systems is that they are very task-oriented and focus on the support of the dedicated business process knowledge workers have to deal with.

The emergence of cloud-computing played an essential role in changing the IT-landscape situation from on-premise systems to affordable cloud solutions. As one benefit of cloud systems, their business models can be named: pay-per-use subscription models can help companies of every size to use powerful systems by only paying what they are using. Cloud platforms like MS Azure, or Amazon Web Services offer whole ecosystems for companies to use integrated database services, virtual machines, web services, BA/BI Tools or AI services.

One of these cloud-based concepts is the idea of LowCode/NoCode Platforms (further LCNC platforms), which enable the development of cloud-based solutions without traditional coding in a text-based editor. LCNC platforms rely on graphical interfaces to increase the speed of software development and loosen up the connection to the IT developers. In contrast to standard toolkits, the range of possibilities for the end-user is much more extensive than in toolkits usually provided for a dedicated case.

By trying to keep a balance between being easy enough for a knowledge worker to develop a simple solution and is sturdy enough for professional developers, LCNC platforms attempt to serve both target groups [4]. Another benefit of LCNC platforms besides saving time and costs in professional software development is the integration of other departments in a manageable way to improve the business process support level of information systems. As a future result, shadow IT would be able to produce manageable, scalable and compliant applications, which can be integrated into other systems too.

While LCNC platforms sound like a promising idea, it is also very disruptive and thus can encounter resistance from within organizations. IT-departments, for example, might fear for their jobs or loss of credibility. After years of telling stakeholders inside their company that it takes large budgets and long implementation times to establish enterprise software, similar results can now be produced with a fraction of people, time and money when using LCNC platforms. Additionally, professional developers (i.e., coders) might prefer to code instead of working with graphical interfaces – whether it makes sense or not [4]. Resistance might also come from the unwillingness of IT departments to explicitly give away software creation responsibilities to other departments.

The authors of the paper are convinced of LCNC platforms as a chance for companies to effectively support knowledge workers in their daily work and keep the system developments monitored and controlled. The first indicator if the new technology will be used can be acceptance testing. Therefore the study deals with the

acceptance of LCNC platforms and elaborates the factors which influence the acceptance most to get at least some practical advice for implementations.

2 Theoretical Foundations

To get an idea of the acceptance of new technology, first of all, the authors had to focus on a geographical limitation to get experts on the side of providers and the side of users/future users for LCNC platforms. The second limitation the authors had to deal with was the decision about which LCNC platform to go with. Based on the assumption and own experience of the dissemination the authors will focus on Microsoft products to give participants a tangible example of LCNC platforms before taking part in the survey. The alignment on knowledge workers leads to the use of a user-centric technology acceptance model. Based on the given restrictions, the following research question will be answered: What is the current acceptance for LCNC platforms in companies located in German-speaking countries?

There are lots of different models out there with often discussed pros and cons, but for this study, the authors decided to go for a modified version of the TAM2 model developed by Opitz, Langkau, Schmidt, and Kolbe [5]. Their model was used to answer questions about the acceptance of cloud computing in Germany and should lead to representative results of the conducted study on the acceptance of LCNC Platforms. In TAM related literature, the line between acceptance and adoption is slightly blurred. This might originate from the fact that TAM has been proposed initially to examine user acceptance and subsequently determine whether users would adopt technology for personal use [6, 7]. For this first study on the acceptance of LCNC platforms for knowledge workers, the authors decided not to take the organizational aspects into consideration and therefore do not go for an enhanced model like the I-TOE by Rosli et al. [8].

The basis of the research design encompasses the hypotheses dealing with the core variables of the TAM2 [9] which has also been proposed for the original TAM [7]. Perceived Usefulness of the TAM2, as well as comparable constructs from other

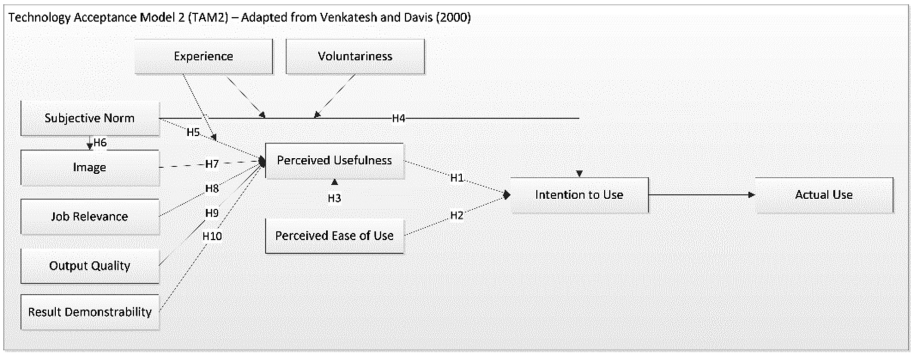

Fig. 1. TAM Model with the suggested correlations based on H1–H10

models like Job-Fit [10], Relative Advantage [11], and Outcome Expectations [12], has shown to be the strongest predictor of Intention to Use and remained significant in both voluntary and mandatory settings [13].

For measuring the theoretical constructs, validated items have been adopted from prior research to fit the context of this study. The same items as in the original TAM2 model [9] have been used. Items for all three original TAM constructs Perceived Usefulness, Perceived Ease of Use, and Intention to Use originate from Davis, Bagozzi, and Warshaw [14] and Davis [9]. Items for Image and Result Demonstrability originally have been proposed by Moore and Benbasat [11]. Items for Subjective Norm originate from Taylor and Todd [15]. Items for Job Relevance and Output Quality originate from Davis et al. [16]. Items for Voluntariness have been taken from Venkatesh and Davis [9].

Besides the constructs and items that have been adopted from the declared and given models, further items have been added to raise demographical data about the participants and the companies they are working in:

- gender (male, female, not specified),
- age (years),
- experience with LCNC platforms (yes, no),
- development of "shadow IT" (often, sometimes, rarely, never),
- position working in (head of a department, team leader, employee, assistant)
- company size based on the Austrian law (<10, 10–50, 51–250 and >250).

To investigate the given research question with the proposed research model, an online questionnaire has been set up with two different parts: (1) questions regarding the based TAM model and (2) questions regarding the demographic situation of every participant. There was a wide range of employees taken for participation based on the variety of use of LCNC platforms. After a pre-test with five participants, the questionnaire was sent out to more than 2000 relevant business experts, and the return rate was at 6%.

3 Results

From the survey, after data clearance, 106 accurate records have been retrieved (N = 106). The gender among participants is relatively unbalanced with 80 (75.5%) being male and 26 (24.5%) being female. Age among participants reaches from 22 to 57 years (mean = 38.94%, standard deviation = 8.908). Twenty participants (18.9%) stated to never make their solutions using tools like Excel or Access while 37 participants (34.9%) said rarely, 30 participants (28.3%) said sometimes, and 19 participants (17.9%) said often. Thirty-eight participants (35.8%) claimed to have already used LCNC platforms before, 66 (62.3%) did not, and two participants (1.9%) chose "I do not know." The number of participants in leading positions compared to normal employees is rather balanced, with 52 (49%) are in leading positions and 54 (51%) being normal full employees – many knowledge workers are part of the study.

Sixty-nine participants work in companies with more than 250 employees, 24 in companies with 51 to 250 employees, 7 in companies with 10 to 50 employees and 5 in companies with less than ten employees.

In the original TAM2 study by Venkatesh and Davis [9], the influence of Voluntariness on the effect of Subjective Norm on Intention to Use and the influence of Experience on the effects of Subjective Norm on Perceived Usefulness and Intention to Use has been examined by splitting the participants into respective voluntary/mandatory settings and experience groups. Due to the total sample size of 106, splitting participants into experienced/inexperienced as well as voluntary/mandatory would have led to groups which are too small for meaningful analysis. Hence, Experience and Voluntariness as moderating factors have been omitted from further analysis. Consequently, the hypotheses, which were concerned with these now oppressed variable constructs, were dropped/changed. H4a and H4b were merged into one single hypothesis H4 that reads "Subjective Norm will have a positive effect on Intention to Use." Hypothesis H5b was dropped after that hypothesis H5a was renamed to H5. All dedicated hypotheses are given in the appendix.

As a first step, the reliability of TAM2 constructs has been analyzed by calculating Cronbach's alphas with SPSS Statistics. Cronbach's alpha values reached from questionable to excellent with Output Quality having the lowest value at .656 and Perceived Usefulness having the highest value at .944. Due to the low Cronbach's alpha value, the construct of Output Quality was omitted together with hypothesis H9. Additionally, the item RD4 has been omitted in order to reach a better Cronbach's alpha value for Result Demonstrability. Afterward, factor analysis has been conducted with the remaining items. Since the model has already been validated before and its constructs and hypotheses are profoundly grounded in theory, confirmatory factor analysis has been conducted with SPSS Amos instead of exploratory factor analysis.

The factor loadings from the confirmatory factor analysis have been used to calculate the construct values from the respective items. Subsequently, three regression analyses have been conducted to test the hypotheses H1 to H10, exploring the effects of the various independent variables on the dependent variables Image, Perceived Usefulness and Intention to Use. Preliminary to the regression analyses, a correlation matrix (Table 1) has been created. Considering the hypotheses, it can be seen that Job Relevance has a moderate positive correlation with Image. All influencing factors of Perceived Usefulness except Perceived Ease of Use exhibit a significant correlation with it whereby the correlation between Result Demonstrability and Perceived Usefulness has to be considered as rather low. Both Subjective Norm and Perceived

Table 1. Pearson correlations between TAM2 constructs

	IU	PU	PEU	SN	RD	IMG	JR
IU							
PU	791***						
PEU	.119	.023					
SN	.458***	.569***	.083				
RD	.326***	.302**	.582***	.278**			
IMG	.634***	.645***	-.045	.513***	.156		
JR	718***	.711***	.026	.486***	.311**	.550***	

*p < .05 **p < .01 ***p < .001

Usefulness significantly positively correlated with the Intention to Use. Again, the correlation with Perceived Usefulness is insignificant. Furthermore, it can be seen that there are moderate correlations between constructs, which will be used together as independent variables in the regression analyses, which could lead to multicollinearity problems within the individual regression analyses.

First, simple regression analysis has been conducted to examine the influence of Subjective Norm on Image. The ANOVA shows that the model as a whole is significant ($F(1, 104) = 37.187$, $p < .001$). The adjusted R square value of .256 shows that Subjective Norm can explain 25,6% of the variance in Image.

Second, a multiple regression analysis examining Perceived Usefulness has been conducted. The ANOVA shows that the model as a whole is significant ($F(5, 100) = 33.991$, $p < .001$). An analysis shows that the independent variables with an adjusted R square value of .611 can explain 61,1% of the variance in Perceived Usefulness. Data additionally show that Job Relevance has the strongest significant positive effect on Perceived Usefulness with $\beta = .403$ ($p < .001$), followed by Image with $\beta = .371$ ($p < .001$), and Subjective Norm with $\beta = .205$ ($p < .05$), wherefore $H5_0$, $H7_0$, and $H8_0$ can be rejected. $H3_0$ and $H10_0$ cannot be rejected since Perceived Ease of Use, and Result Demonstrability show no significant effect on Perceived Usefulness. With all collinearity tolerance values > .2 and all VIFs < 3 it can be assumed that there are no multicollinearity issues.

Lastly, third multiple regression analysis has been conducted to examine the Intention to Use. The ANOVA shows that the model as a whole is significant ($F(3, 102) = 59.506$, $p < .001$). An analysis shows that the independent variables with an adjusted R square value of .626 can explain 62,6% of the variance in Intention to Use. Data additionally show that Perceived Usefulness is the only independent variable having a significant effect on Intention to Use with $p < .001$. The effect of furthermore is very high with $\beta = .700$. Both Subjective Norm and Perceived Ease of Use do not exert a significant effect on Intention to Use. Therefore, $H1_0$ can be rejected whereby $H2_0$ and $H4_0$ cannot be rejected. That the effect of Subjective Norm on Intention to Use is insignificant corresponds with assumptions of the TAM2 since settings were predominantly voluntary. With all collinearity tolerance values > .2 and all VIFs < 3 it can be assumed that there are no multi-collinearity issues.

Figure 2 shows the results of all regression analyses within the TAM2 including significance levels.

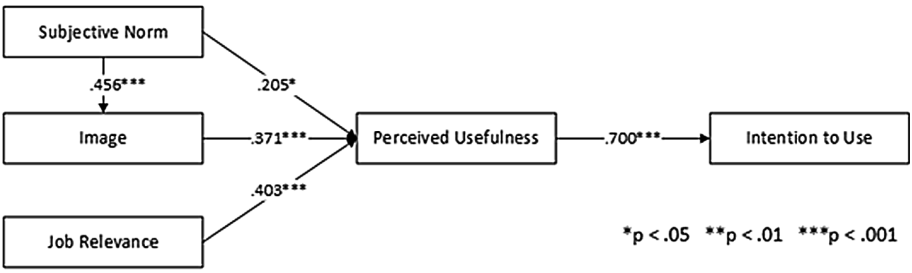

Fig. 2. Regression Results TAM2

4 Discussion of Results

The TAM2 was able to explain 62.6% of the variance in Intention to Use (adjusted R square). The data from this study, however, only supports the direct influence of Perceived Usefulness on Intention to Use. The strength of the effect is similar to the one which was found by Opitz et al. [5] when examining the adoption of cloud computing in companies. The effects of Perceived Ease of Use and Subjective Norm on Intention to Use are insignificant. While the effect of Perceived Ease of Use, in general, is considered a rather weak one compared to the other two constructs, it might have turned insignificant due to the nature of LCNC platforms. LCNC platforms are toolsets which can be used very flexible for various applications rather than one application or system, which is designed to serve a specific purpose. Since the difficulty of usage naturally scales with the complexity of the application, which is to be realized within the platform, there is no clearly defined goal (like completing a task in a clearly defined system/interface) where Ease of Use can be assessed upon. However, the same applies to cloud computing in which Perceived Ease of Use has previously been found to have a significant effect on the Intention to Use [5]. Another reason for the insignificance of Perceived Ease of Use could be that the majority of the participants presumably did not have much practical experience in working with LCNC platforms by themselves. Therefore, they might only have made assumptions about how easy they think it would be to work with LCNC platforms, based on the information they had received.

Next, the TAM2 proposes that the direct effect of Subjective Norm on Intention to Use is only significant in mandatory but not voluntary settings [9]. Subjective Norm did not exert a significant direct effect on Intention to Use which is coinciding with this proposal. It has to be assumed that most participants were prospects or interested parties (IT representatives, key users, decision makers), which did not have real pressure to either implement or use LCNC platforms. The TAM2 furthermore proposes social influences on Perceived Usefulness via both internalization and identification. In the direct influence due to internalization, people incorporate social influences into their usefulness perceptions while this effect is assumed to decrease with increased experience [9, 17]. Although the direct effect of Subjective Norm on Perceived Usefulness was supported, the effect was not very strong when considering again that participants, in general, were not very experienced. Due to the limited sample size, a comparison between an experienced and an inexperienced group of participants could not have been made in this study.

In the indirect influence due to the identification, people are assumed to use a system in order to gain status or influence within a group [17]. This assumption is supported by the data and the significant effect of Subjective Norm on Image. Lastly, the TAM2 proposes effects of cognitive instrumental processes on Perceived Usefulness. It is implied that Job Relevance is affecting judgments about how useful a system is because individuals match their job goals with the consequences of using the system [9]. With Job Relevance having the strongest effect on Perceived Usefulness, compared to Image and Subjective Norm, this implication is supported by the results of this study. Job Relevance furthermore strongly positively correlates with Intention to Use with $r = .718$ ($p < .001$).

With finding the negative impact of the factor *Complexity*, one practical implication can be the necessity of ease to deploy and implement into IT infrastructure as well as into the work practice for all knowledge workers. Suppliers of LCNC platforms can additionally offer a comprehensive toolset within the platform based on streamlined interfaces and new functionalities. It is essential to take the positive impact from the factor *Compatibility* into consideration and focus on internal and external systems without causing too much disruption. If companies want to go for LCNC platforms to support knowledge workers, it is essential to illustrate potential benefits to future users and future system administrators. Knowledge workers are willing to learn and use this new technology.

5 Limitations and Future Work

As shown in the methodology chapter, the selection of the region and the selection of Microsoft Business Application Platform for explanations are two strict limitations of the study. Currently, there is no extensive use of LCNC platforms in companies in the elaborated region, and therefore participants had to be informed about the topic before filling out the questionnaire in order to produce valid answers - an explanatory video did this. Combined with the lack of own experience, it is implied that participants' attitudes might have been shaped by the inputs that came from the video when answering the questionnaires.

This study solely aimed at companies including Austria, Germany, and Switzerland, which have a similar cultural background. To validate the outcomes of this study, similar studies could be conducted in other regions of the world with different cultural backgrounds. Because LCNC platforms target several groups within a company – reaching from different departments to different positions and job profiles – it would be fascinating to investigate how acceptance varies within those different groups. Unfortunately, this study failed in making the comparison between the groups by not gathering enough responses to split the sample into meaningful groups.

Appendix

Given are the H1–H10 used for the model shown in Fig. 1:

Hypothesis 1: Perceived Usefulness will have a positive effect on the Intention to Use.
Hypothesis 2: Perceived Ease of Use will have a positive effect on the Intention to Use.
Hypothesis 3: Perceived Ease of Use will have a positive effect on Perceived Usefulness.
Hypothesis 4a: Subjective Norm will have no significant effect on the Intention to Use when usage is perceived to be voluntary.

Hypothesis 4b: Subjective Norm will have a positive direct effect on Intention to Use when usage is perceived to be mandatory.
Hypothesis 5a: Subjective Norm will have a positive effect on Perceived Usefulness.
Hypothesis 5b: The positive effect of Subjective Norm on Perceived Usefulness will attenuate with increased experience.
Hypothesis 6: Subjective Norm will have a positive effect on Image.
Hypothesis 7: Image will have a positive effect on Perceived Usefulness.
Hypothesis 8: Job Relevance will have a positive effect on Perceived Usefulness.
Hypothesis 9: Output Quality will have a positive effect on Perceived Usefulness.
Hypothesis 10: Results Demonstrability will have a positive effect on Perceived Usefulness.

References

1. Maier, R., Hädrich, T., Peinl, R.: Enterprise Knowledge Infrastructures, 2nd edn. Springer, Heidelberg (2009). https://doi.org/10.1007/978-3-540-89768-2
2. Maier, R.: Knowledge Management Systems: Information and Communication Technologies for Knowledge Management, 3rd edn. Springer, Heidelberg (2007). https://doi.org/10.1007/978-3-540-71408-8
3. Satell, G.: The Future of Software is No-Code (2018). https://www.inc.com/greg-satell/how-no-code-platforms-are-disrupting-software.html. Accessed 15 Dec 2018
4. Bloomberg, J.: The Low-Code/No-Code Movement: More Disruptive Than You Realize (2017). https://www.forbes.com/sites/jasonbloomberg/2017/07/20/the-low-codeno-code-movement-more-disruptive-than-you-realize/#16c5e355722a. Accessed 15 Dec 2018
5. Opitz, N., Langkau, T.F., Schmidt, N.H., Kolbe, L.M.: Technology acceptance of cloud computing: empirical evidence from German IT departments. In: Sprague, R.H. (ed.) 2012 45th Hawaii International Conference on System Science: (HICSS); USA, 4–7 January 2012, pp. 1593–1602. IEEE, Piscataway (2012). https://doi.org/10.1109/HICSS.2012.557
6. Davis, F.D.: A technology acceptance model for empirically testing new end-user information systems: theory and results. Massachusetts Institute of Technology (1985)
7. Davis, F.D.: Perceived usefulness, perceived ease of use, and user acceptance of information technology. MIS Q. **13**(3), 319 (1989). https://doi.org/10.2307/249008
8. Rosli, K., Yeow, P., Siew, E.-G.: Factors influencing audit technology acceptance by audit firms: a new I-TOE adoption framework. J. Acc. Auditing Res. Pract. 1–11 (2012). https://doi.org/10.5171/2012.876814
9. Venkatesh, V., Davis, F.D.: A theoretical extension of the technology acceptance model: four longitudinal field studies. Manage. Sci. **46**(2), 186–204 (2000). https://doi.org/10.1287/mnsc.46.2.186.11926
10. Thompson, R.L., Higgins, C.A., Howell, J.M.: Personal computing: toward a conceptual model of utilization. MIS Q. **15**(1), 125 (1991). https://doi.org/10.2307/249443
11. Moore, G.C., Benbasat, I.: Development of an instrument to measure the perceptions of adopting an information technology innovation. Inf. Syst. Res. **2**(3), 192–222 (1991). https://doi.org/10.1287/isre.2.3.192
12. Compeau, D.R., Higgins, C.A.: Computer self-efficacy: development of a measure and initial test. MIS Q. **19**, 189–211 (1995)

13. Venkatesh, V., Morris, M.G., Davis, G.B., Davis, F.D.: User acceptance of information technology: toward a unified view. MIS Q. **27**(3), 425 (2003). https://doi.org/10.2307/30036540
14. Davis, F.D., Bagozzi, R.P., Warshaw, P.R.: User acceptance of computer technology: a comparison of two theoretical models. Manage. Sci. **35**(8), 982–1003 (1989). https://doi.org/10.1287/mnsc.35.8.982
15. Taylor, S., Todd, P.A.: Understanding information technology usage: a test of competing models. Inf. Syst. Res. **6**(2), 144–176 (1995). https://doi.org/10.1287/isre.6.2.144
16. Davis, F.D., Bagozzi, R.P., Warshaw, P.R.: Extrinsic and intrinsic motivation to use computers in the workplace1. J. Appl. Soc. Psychol. **22**(14), 1111–1132 (1992). https://doi.org/10.1111/j.1559-1816.1992.tb00945.x
17. Kelman, H.C.: Compliance, identification, and internalization three processes of attitude change. J. Conflict Resolut. **2**(1), 51–60 (1958)
18. Reinhardt, W., Schmidt, B., Sloep, P., Drachsler, H.: Knowledge worker roles and actions – results of two empirical studies. Knowl. Process Manage. **18**(3), 150–174 (2011). https://doi.org/10.1002/kpm.378