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Use of the Manufacturing Execution System in Practice: Understanding the end Users and the Acceptance of the System

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RESUMO

Propósito - Examinar os fatores que afetam a aceitação e o uso do Sistema de Execução da Manufatura na visão dos usuários finais, utilizando o modelo da Teoria Unificada de Aceitação e uso da Tecnologia (UTAUT).
Referencial Teórico - O modelo de aceitação de tecnologia baseia-se nos princípios adotados no paradigma de atitude da psicologia, que especifica como medir os componentes de atitudes relevantes do comportamento; distingue crenças e atitudes e específica como estímulos externos, as características objetivas de um objeto de atitude, são causalmente ligados a crenças, atitudes e comportamento.
Design/metodologia/abordagem - Os dados foram coletados pelo método survey, utilizando a escala Likert de sete pontos. A abordagem foi quantitativa, utilizando a técnica de Modelagem de Equações Estruturais, utilizando o software SPSS V.25.
Achados - Os achados deste estudo mostraram que as Condições Facilitadoras influenciam o Comportamento de Uso dos usuários do Sistema de Execução de Manufatura. A aplicação da análise de comparação multigrupo (MGA) mostrou que a Expectativa de Esforço influencia positivamente a Intenção Comportamental e a Influência Social também afeta positivamente a Intenção Comportamental.
Pesquisa, implicações práticas e sociais - O estudo traz contribuições relevantes em relação aos aspectos de compreensão sobre o nível de aceitação dos usuários finais do MES na fase de operação.
Originalidade/Valor - Este trabalho traz uma contribuição para a literatura devido ao pioneirismo da pesquisa, uma vez que não foram encontradas pesquisas em bases acadêmicas que abordem o uso do UTAUT com o sistema MES. Outra contribuição importante é que este estudo propõe um novo modelo, baseado no UTAUT utilizando a aplicação do MGA.
Palavras-chave: Aceitação e Uso. Tecnologia. Sistema Execução Manufatura.

ABSTRACT

Purpose *– this paper aims to examine the factors that affect the acceptance and use of the Manufacturing Execution System from the point of view of end users, using the Unified Theory of Acceptance and Use of Technology (UTAUT) model.*
Theoretical framework *- The technology acceptance model is based on principles adopted in the attitude paradigm of psychology, which specifies how to measure the relevant attitudinal components of behavior; distinguishes beliefs and attitudes and specific as external stimuli, the objective characteristics of an attitude object, are causally linked to beliefs, attitudes and behavior.*
Design/methodology/approach *- Data were collected by the survey method, using the seven-point Likert scale. The approach was quantitative, using the Structural Equation Modeling technique, using SPSS V.25 software.*
Findings *- The findings of this study showed that the Facilitating Conditions influence the Usage Behavior of users of the Manufacturing Execution System. The application of multi-group comparison analysis (MGA) showed that Effort Expectancy positively influences Behavioral Intention and Social Influence also positively affects Behavioral Intention.*
Research, Practical & Social implications *- The study brings relevant contributions in relation to aspects of understanding about the level of acceptance of MES end users in the operation phase.*
Originality/value *- This paper makes a contribution to the literature due to the pioneering nature of the research, since no research was found in academic bases that address the use of UTAUT with the MES system. Another important contribution is that this study proposes a new model, based on UTAUT using the application of MGA.*
Keywords *- Acceptance and Use. Technology. Manufacturing Execution System.*

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1. INTRODUCTION

The development of Information and Communication Technologies (ICT), including industrial computing and technological advances in information systems, have provided a viable solution to the growing needs for the integration of information in the manufacturing and service sectors, supporting the operations of the global supply network (ROMERO; VERNADAT, 2016).

The Manufacturing Execution System (MES) began to evolve from the late 1970s as a system of quality management, equipment monitoring and production process tracking (YOUNUS et al, 2010). MES is the specific type of enterprise system used to integrate data and be comprehensive in supporting the company's core manufacturing functions. It provides enhanced visibility, integration, resource management, and control of documents and products, which provide greater productivity and quality (ELLIOTT, 2013). In other words, MES bridges the gap between the Enterprise Resource Planning (ERP) and manufacturing control systems (DEUEL, 1994).

This study investigates the level of acceptance from end users in the adoption of the MES, in view of the operation phase (post-implementation). The motivation for the development of this study is, first of all, that the literature demonstrates that the system can clearly improve competitiveness, through correct adoption and acceptance of the system (GOVINDARAJU; PUTRA, 2016; ELLIOTT, 2013; YOUNUS *et al*., 2010).

The observations made in the MES implementation studies indicate the need for further complementary studies, addressing other aspects related to the system implementation process. Lee, Hong, Katerattanakul, and Kim (2012) proposed new studies on the implementation of the MES because users' perceptions may come to be more positive once they become familiar with the system. According to the study by Govindaraju and Putra (2016), when successfully implemented, MES has positive effects on user efficiency and the manufacturing automation process, in addition to being one of the strategies adopted by companies in their efforts to increase competitiveness in the face of globalization. Increasing the effectiveness of information systems becomes increasingly more crucial for organizations, although user acceptance may hinder adoption success.

No studies on the level of acceptance of users in the operation phase of the MES were found in bibliometric research. Consequently, we can consider that the system can be

successfully implemented from a technical perspective, but this success depends on the users' attitudes towards the actual use of the system (ELLIOTT, 2013).

That said, the question that guided this research was: what are the factors that affect the acceptance and use of a manufacturing execution system, from the perspective of end users?

The general objective of the study was to evaluate which factors affect the acceptance and use of the Manufacturing Execution System (MES) in the view of end users, using the model of the Unified Theory of Acceptance and Use of Technology (UTAUT).

2. THEORETICAL FOUNDATION

2.1 Manufacturing Execution System (MES)

MES is a technology that belongs to the scientific subject of information systems, and it began to evolve from the late 1970s as a system for quality management, equipment monitoring, and production process tracking (YOUNUS *et al*., 2010). It is a specific type of enterprise system used to integrate data and be comprehensive in supporting the company's core manufacturing functions. It provides enhanced visibility, integration, resource management, and also document and product control, which provides greater productivity and quality (ELLIOTT, 2013).

It is also considered a manufacture scheduling and tracking system used to analyze and report the availability and status of resources, schedule the production of orders, collect real-time data from materials in use, parameters of products in production, service order, and status of machines and other critical information. It is used to report and monitor manufacturing activities in real time and to feed the ERP back, with the advancement of production orders. (YOUNUS *et al.*, 2010).

The system has characteristics that are unique and different from other information systems (IS). First, unlike traditional information systems used by users who work in offices, MES is primarily used by manufacturing users and team managers. Consequently, the user interfaces must be simple, and the system operation easy and user-friendly. The active participation of workers in the development and implementation of the MES is essential (LEE *et al*., 2012).

2.2 Acceptance and use of Information Systems

Studies conducted in developed countries showed that the introduction of IT in organizations contributed to productivity gains, which resulted in a general enrichment for society. The adoption of IT brought many challenges related to the process of its implementation, one of which concerns the interaction of individuals with technologies, namely: the acceptance of IT. To address this challenge, countless theories and models have been used to investigate factors that influence the use of computers and related devices or applications. These theories and models aim to explain use behavior by considering a range of independent variables in different environments (KHECHINE *et al*, 2016).

The technology acceptance model is based on the principles adopted in the attitude paradigm of psychology, which specifies how to measure the components of relevant behavior attitudes; it distinguishes beliefs and attitudes and specifies how external stimuli, the objective characteristics of an attitude object, are causally linked to beliefs, attitudes and behavior (DAVIS, 1993).

Explaining user acceptance of new technologies is often described as one of the most mature research areas in the Information Systems (IS) literature. Studies in this area have resulted in several theoretical models, with roots in information systems, psychology and sociology, which routinely explain more than 40% of the variation in individual intention to use technology (VENKATESH *et al*., 2003).

2.3 Unified Theory of Acceptance and Use of Technology (UTAUT)

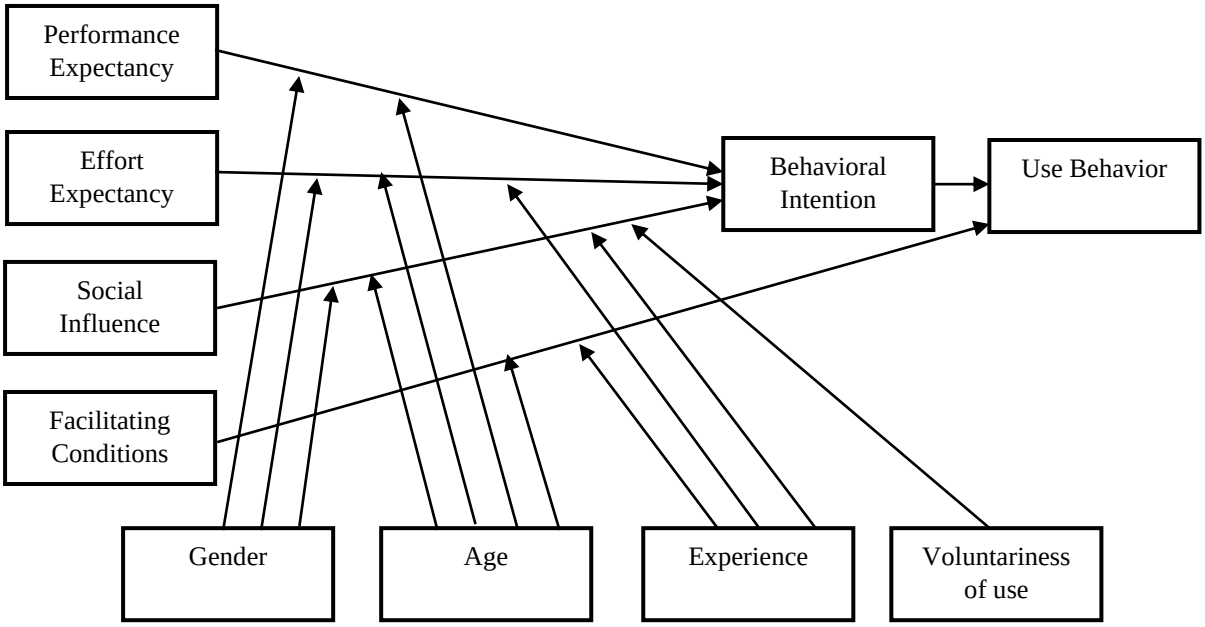
The UTAUT model was developed by Venkatesh *et al*. (2003) and is the result of a synthesis of eight different theories of acceptance, diffusion and use of technology: the theory of reasoned action (TRA); the technology acceptance model (TAM) (DAVIS, 1989); the motivational model (MM) (DAVIS *et al*, 1992); the theory of planned behavior (TPB) (AJZEN, 1991); the combined theory of planned behavior/technology acceptance model (C-TPB-TAM) (TAYLOR; TODD, 1995); the model of personal computer utilization (MPCU) (THOMPSON *et al*, 1991); the innovation diffusion theory (IDT) (ROGERS, 1995); and social cognitive theory (SCT) (COMPEAU; HIGGINS, 1995).

Venkatesh *et al.* (2003) developed UTAUT in order to help future research in the field

of information technology acceptance behavior. Based on this integrated model, researchers are able to discover which factors influence user behavior.

The most important advantage of UTAUT compared to the eight existing models is that it was able to explain up to 70% of the variation in use behavior (VENKATESH *et al.*, 2003). This advantage makes the UTAUT model the best conceptual framework to explain the intention, acceptance and use of information technologies in enterprises. The empirical findings through the original UTAUT model greatly drew the attention of scholars, who tested it in various technological fields. Figure 1 shows the UTAUT model.

Figure 1. The Unified Theory of Acceptance and Use of Technology Model – UTAUT.



Source: Venkatesh, V.; Morris, M.G.; Davis, G.B.; Davis, F.D. (2003).

2.3.1 Variables, hypotheses and theoretical model

The new structure integrated the eight previous models and concepts related to the main dimensions of the UTAUT: Performance Expectancy, Effort Expectancy, Social Influence, Facilitating Conditions, and Behavioral Intention; as well as four control variables: Gender, Age, Experience, Voluntariness of Use. The main dimensions and control variables of the UTAUT model, as per Venkatesh *et al*. (2003), are shown below in Charts 1 and 2 respectively:

Chart 1 - Main dimensions and control variables of the UTAUT model.

Variable	Description	Hypotheses
Performance Expectancy	Defined as the degree to which an individual believes that system use will help them achieve gains in job performance. The five constructs of the different models that belong to the Performance Expectancy are: perceived utility (TAM / TAM2 and C-TAM-TPB), extrinsic motivation (MM), adjustment to work (MPCU), relative advantage (IDT) and outcome expectations (SCT) (VENKATESH et al., 2003).	H1: Performance Expectancy positively influences Behavioral Intention.
Effort Expectancy	Defined as the degree of ease associated with the use of the system. Three constructs of the existing models capture the concept of Effort Expectancy: perceived ease of use (TAM / TAM2), complexity (MPCU) and ease of use (IDT) VENKATESH et al., 2003).	H2: Effort Expectancy positively influences Behavioral Intention.
Social influence	Defined as the degree to which an individual realizes that other important individuals believe that he or she should use the new system. Social Influence as a direct determinant of Behavioral Intention is represented as a subjective norm in TRA, TAM2, TPB / DTPB and C-TAM-TPB, social factors in MPCU and image in IDT (VENKATESH et al., 2003).	H3: Social Influence positively influences Behavioral Intention.
Facilitating Conditions	Defined as the degree to which an individual believes that there is an organizational and technical infrastructure to support the use of the system (VENKATESH et al., 2003).	H4: Facilitating Conditions positively influence Use Behavior.
Behavioral Intention	Defined as the degree to which a person has formulated conscious plans to perform or not perform some specified future behavior (VENKATESH et al., 2003).	H5: Behavioral Intention positively influences Use Behavior.

Source: The authors.

In addition to the main dimensions above, there are also, four moderating variables, as previously mentioned, that indirectly affect behavioral intention (Gender, Age, Experience and Voluntariness of use), as shown in Chart 2.

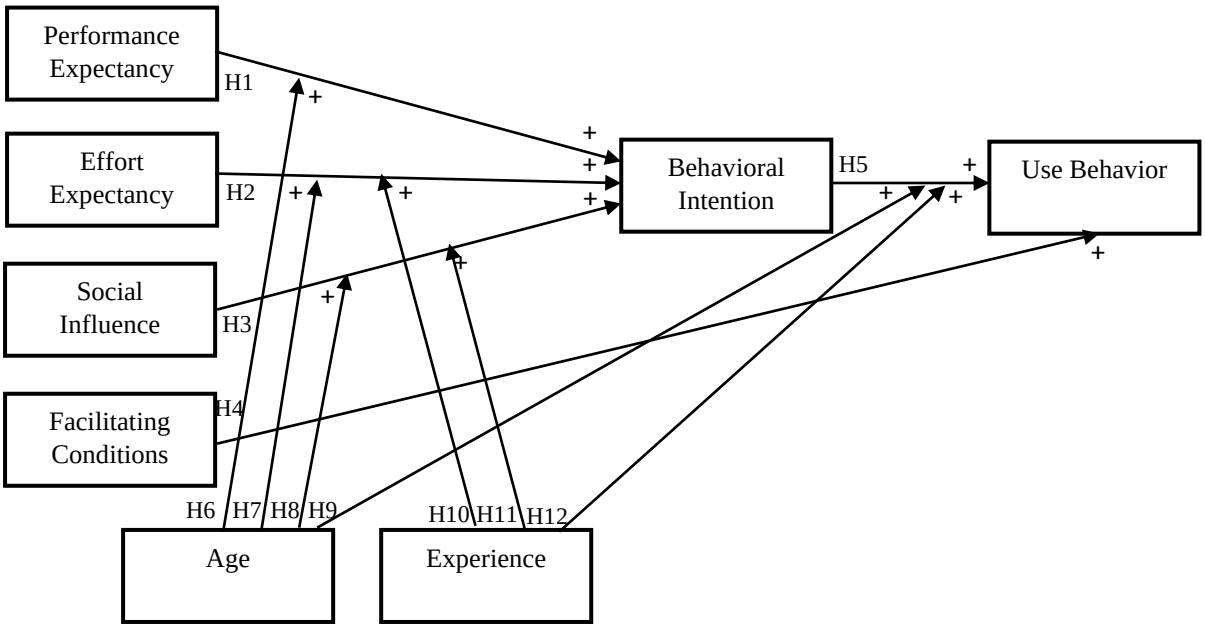
Chart 2 – Moderator variables that indirectly affect behavioral intention.

Variables	Description	Hypotheses
Gender	Venkatesh et al. (2003) observed that women tend to be more sensitive to the opinions of others and therefore consider social influence more salient when forming an intention to use new technologies	For this moderating variable, no hypotheses will be proposed because the research sample public is marked by the predominance of male individuals
Age	According to Venkatesh et al. (2003), studies on work-related attitudes suggest that younger workers may give more importance to extrinsic rewards.	H6: Age has a moderating effect on the relationship between Performance Expectancy and Behavioral Intention. H7: Age has a moderating effect on the relationship between Effort Expectancy and Behavioral Intention. H8: Age has a moderating effect on the relationship between Social Influences and Behavioral Intention. H9: Age has a moderating effect on the relationship between Behavioral Intention and Use Behavior.
Work Experience	Venkatesh et al. (2003) identified work experience as a moderating variable, and previous research suggests that individuals are more likely to meet the expectations of others when they have the ability to reward desired behavior or punish non-behavior.	H10: Age has a moderating effect on the relationship between Effort Expectancy and Behavioral Intention. H11: Experience has a moderating effect on the relationship between Social Influence and Behavioral Intention. H12: Age has a moderating effect on the relationship between Behavioral Intention and Use Behavior.
Voluntariness of Use	In the original UTAUT model, it is expected that the voluntariness of use moderates the effect of social influence on behavioral intention. Volunteerity of use is defined as the extent to which people or organizations believe that their use and acceptance of technologies are perceived as volunteer or free willed (VENKATESH et al., 2003).	Voluntariness of Use was not considered either, since the use of the system by users occurs regardless of their will, as it was defined by the company.

Source: The authors.

The conceptual model presented in Figure 2 was designed based on the theoretical background and consists of an adaptation of the constructs identified in the UTAUT study, by Venkatesh et al. (2003). In this model, the moderating variable Gender was not considered because the public that participated in the research sample is marked by the predominance of males. Finally, Voluntariness of Use was not considered either, since the use of the system by users occurs regardless of their will, being defined by the company.

Figure 2 - Conceptual Model with Hypotheses.



Source: The authors.

3. METHODOLOGICAL PROCEDURES

The field research is characterized by the quantitative approach, through the application of the Survey technique (MALHOTRA, 2012). The universe of the research is characterized by employees who work in the areas of Manufacturing and Quality, which total 890 people. The data collection technique involved the autofill procedure of a questionnaire with 40 questions, and the sampling should be considered non-probabilistic (MALHOTRA, 2012), since the completion of said questionnaires came from the volunteer adherence from the components of the research universe. Data collection was carried out within 21 days through a survey form prepared and made available online through the *Google Forms* tool.

Concerning the data collection instrument, in addition to the respondent identification variables (age, time of experience with the system, module of the system used), previously validated scales were used to measure the theoretical constructs which form the model.

All of the items used to measure the theoretical constructs were applied considering a 7-point Likert-type interval agreement scale (MALHOTRA, 2012), which ranged from 1 (Strongly disagree) to 7 (Strongly agree).

The final sample reached a corpus of 121 (one hundred and twenty-one) questionnaires collected. Following the guidelines by Hair *et al.* (2009), the presence of missing data (missings) should be analyzed initially. For this study, given that the electronic collection system did not allow the respondent to leave questions blank, no presence of missing data was recorded.

With regard to data analysis procedures, nonparametric tests of average comparisons and Structural Equation Modeling were used through the Partial Least Squares approach. Considering the parameters for the evaluation of the statistical tests, a confidence level of 95% (sig $\leq$ 0.05) was adopted as the criterion for analysis.

To compare the means of each construct with the different groups that make up the sample, we chose to use the Kruskal-Walis test (KW), through the use of the SPSS V.25 software. According to Malhotra and Birks (2006), this test is recommended for independent samples and does not require the data distribution to be normal.

To test the model, we chose the Structural Equation Modeling technique, based on the partial least squares approach. According to Hair et al. (2014), this approach is adequate to determine predictions, for small samples and when the theoretical model has variables which are observable or measured from a single item. Still according to the authors, the Structural Equation Modeling technique covers two blocks. The Measurement Model (OuterModel*)* covers the indicators used to measure latent constructs and covers the relationships between such items and their respective constructs.

With regard to the parameters for verifying the adequacy of the sample, as described by Hair et al. (2014), the Ten Times rule and the verification of the Statistical Power of Explanation were used. The Ten Times rule indicates that "the sample size must be equal to or greater than 10 times the largest number of formative indicators used to measure a single construct, or 10 times the largest number of structural paths directed to a particular reflective construct of the structural model" (HAIR *et al*., 2014, p. 20).

The Statistical Power of Explanation (COHEN, 1992) indicates the ability of Structural Equation Modeling to identify important relationships that actually exist, determining the level of significance and coefficient of determination (R^2) that a given sample can obtain. According to Hair *et al*. (2009), researchers usually adopt a level of statistical power of 80% as acceptable.

As for the analysis procedures related to Structural Equation Modeling, given the need to evaluate the existence of moderating effects envisaged in the model, it was necessary to perform comparison tests between groups. Therefore, according to the guidelines of Hair et al (2014), the Multigroup Analysis test (PLS-MGA), which, in addition to serving as a method for detecting data heterogeneity, verifies the existence of significant differences between the path coefficients and the significance levels of the relationships, was chosen to test the existence of a statistically significant moderating effect. It is worth mentioning that, according to the authors, the effect of moderation involves the influence that a given variable has on the relationship between two variables that make up the model.

Table 1 presents the items used to measure the theoretical constructs that make up the study. The data collection instrument envisages the measurement of 6 (six) first-order reflective theoretical constructs, measured from a set of 34 (thirty-four) variables. As mentioned, all constructs were measured from the *Likert*-type agreement scale, with a range that spans from 1 (Strongly Disagree) to 7 (Strongly Agree).

Table 1 -Scale items for theoretical construct measuring.

CODE	CONSTRUCT	QUESTION
BI1	Behavioral Intention	I intend to use the MES in the coming months.
BI2		I will be using the MES in the coming months.
BI3		I plan to use the MES in the coming months.
BI4		I will use the MES in the coming months.
EE1	Effort Expectancy	My interaction with the MES is clear and comprehensive.
EE2.		It is (or was) easy to become nimble in using the MES.
EE3		I find the MES easy to use.
EE4.		Learning to use the MES was easy for me.
FC1	Facilitating Conditions	I have the required means to use the MES.
FC2		I have the required knowledge to use the MES.
FC3		The MES is not compatible with other systems I use. (*)
FC4		I have support in the difficulties with the MES when needed.
PE1	Performance Expectancy	Using MES allows me to finish my tasks faster.
PE2		When I use the MES, I increase my chances of obtaining professional recognition.
PE3		I find the MES useful in my daily work.
PE4		Using the MES increases my productivity.
SI1	Social influence	The people who influence me think I should use the MES.
SI2		My superior cooperates for me to use the MES.
SI3		In general, the organization has supported the use of the MES.
SI4		People I consider important think I should use the MES.
US1	Use Behavior	Car quality situation
US2		List of existing flaws

CODE	CONSTRUCT	QUESTION
US3		Position of the car throughout the production process
US4		Order list
US5		Result of carried out operations
US6		List of vehicle components
US7		Production Scheduling
US8		Order coverage report
US9		Transit and actions
US10		Vehicle body coverage
US11		Biorial notary
US12		Notary deliberates
US13		SVI - Total SVI anomalies opened in the period
US14		TOP 10 anomalies

*Item with reverse rating. Before starting the data analysis, the rates of this item were reversed
Source: The authors.

4. RESULTS

4.1 Sample characterization

With an interest in maintaining internal coherence in relation to the results of this study, this section presents the characteristics of the sample, considering only the 120 cases that remained in the database after the preliminary analysis procedures. The male MES system users represent 95% of the sample. 37.5% of the respondents are between 22 and 35 years old. Complete and incomplete higher education represents 64.2% of the sample and 41% have between 6 and 15 years of experience with information systems. Regarding the use of *Build* and *Quality* modules, users are divided into 55% and 30.8% for each module, and 14.2% are users of both modules.

4.2 Univariate and multivariate analyses

The tables below present the results related to the minimum, maximum, average, variance, asymmetry and kurtosis values of the items used to measure the theoretical constructs, as well as the general descriptive statistics of each construct. For a principle of internal coherence, these tables consider only the items validated in the adjustment stage of the general measurement model, to be presented later. A complete table, with every item present in the data collection instrument, may be found in Appendix A.

It is worth mentioning that, although the Structural Equation Modeling technique from the partial least squares approach does not require that the data present a normal distribution, Hair et al. (2014) recommend the verification of such element. Thus, in Appendix A, it is possible to verify that most of the variables that make up the questionnaire present non-normal distribution, since their measures of kurtosis and/or asymmetry exceed the range between -1 and +1. Thus, it is verified that the choice of the partial least squares approach proved to be adequate to the distribution of the data gathered in the research.

4.3 Comparison of averages between groups

In order to verify the existence of significant differences between the groups of interviewees, with regard to the means obtained in each theoretical construct, following the guidelines by Malhotra and Birks (2006), the nonparametric Kruskal-Walis test (KW) was used, through the SPSS V.25 software. It is worth mentioning that the gender variable was not included in this analysis, due to the imbalance of the sample (95% of respondents are male), which compromises the quality of statistical tests, since the frequency of women is insufficient to perform such a procedure.

The results indicate the absence of statistically significant differences (at a level of 5%) when comparing the averages obtained in each theoretical construct between the groups.

4.4 Modeling of Structural Equations

4.4.1 Suitability of the sample

The suitability of the sample was verified in the light of the specific recommendations for the application of the Structural Equation Modeling technique. As suggested by Hair et al. (2014), the “Ten Times” rules were considered, as well as the analysis of the Power of the Statistical Test. Given that the final sample consists of 120 (one hundred and twenty) questionnaires and that the construct with the largest number of structural paths deriving from explanatory variables (Behavioral Intention) has three connections, it is clear that, by the “Ten times” rule, the sample size is much higher than the minimum required (30 interviews).

In view of the sample composed of 120 elements, the statistical power of the test was calculated for each relationship envisaged in the model (SOPER, 2018). It should be noted

that such analysis was only possible after the execution of the procedures for analysis of the measurement model, to be presented later. Table 2 reveals that all structural relationships of such a model can be analyzed considering 99% significance levels.

Table 2 - Statistical power of the test.

ENDOGENOUS CONSTRUCT	TEST POWER (SIG=1%)	TEST POWER (SIG=5%)
Behavioral Intention	0.995	0.999
Use Behavior	0.997	0.999

Source: The authors.

4.4.2 Analysis of the Measurement Model

As suggested by Hair et al. (2014), the first step in the analysis of structural equations involves verifying the criteria of the measurement model, which is analyzed based on the observation of reliability levels, convergent validity (AVE and Factorial Charge) and discriminant validity. If these criteria are not met from the measurement structure originally proposed, the authors recommend the exclusion of indicators that compromise such measures. Therefore, Table 3 presents the structure and quality indicators of the measurements, considering the final solution of said model.

Table 3 - Measurement Model Metrics.

CONSTRUCT	COMPOSITE RELIABILITY	AVE	LOWEST FACTORIAL CHARGE	NUMBER OF ITEMS	EXCLUDED ITEMS
Behavioral Intention	0.937	0.789	0.815	4	
Effort Expectancy	0,945	0.811	0.859	4	
Facilitating Conditions	0.826	0,614	0.708	3	FC3
Performance Expectancy	0,866	0.764	0.845	2	PE3; PE4;
Social influence	0.912	0.776	0.863	3	SI3
Use Behavior	0.912	0.541	0.462	9	US1; US2; US12; US13; US14

Source: The authors.

Once the first requirements of the measurement analysis were ensured, following the guidelines of Hair *et al.* (2014), the discriminant validity was verified using the Fornell-Larcker criterion.

Table 4 - Discriminant Validity – Fornell Larcker Criterion.

	1	2	3	4	5	6
1. Behavioral Intention	**0.888**					
2. Effort Expectancy	-0.438	**0.901**				
3. Facilitating Conditions	-0.338	(0.787)	**0.783**			
4. Performance Expectancy	-0.460	0.808	0.711	**0.874**		
5. Social influence	-0.319	0.580	0.617	0.645	**0.881**	
6. Use Behavior	-0.268	0.519	0.449	0.532	0.428	**0.735**

Source: The authors.

In the Table 4 analysis, it could be observed that discriminant validity was achieved by every construct in the model, which allows moving forward to the analysis of the structural model.

4.4.3 Structural Analysis

According to Hair *et al*. (2014), the analysis of the structural model involves verifying the significance, direction, and intensity of the structural relationships that make up the model. In addition, at this stage, the level of explanation of the endogenous variables and the criteria that guarantee the predictive capacity of the model are verified, considering the data set analyzed. Table 5 displays the elements that make up the analysis of the structural model.

Table 5 - Structural Model Metrics.

RELATIONSHIP	VIF	CC	P-VALUES	R^2	ADJUSTED R^2	F^2	Q^2
Effort Expectancy -> Behavioral Intention	2.927	-0.188	0.542	22.4%	20.4%	0.016	-0.175
Performance Expectancy -> Behavioral Intention	3.330	-0.295	0.136			0.034	
Social Influence -> Behavioral Intention	1.743	-0.019	0.932			0.000	
Behavioral Intention -> Use Behavior	1.129	-0.131	0.413	21.7%	20.3%	0.019	0.107
Facilitating Conditions -> Use Behavior	1.129	0.404	0.000			0.185	

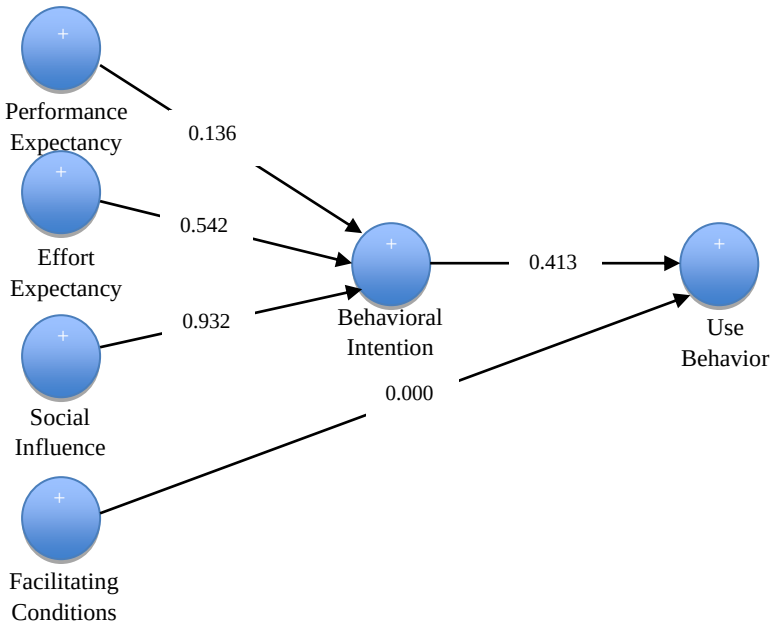
Source: The authors.

The only significant relationship is the one between Facilitating Conditions and Use Behavior (sig=0.000). Thus, it can be understood that the greater the Facilitating Conditions, the greater the use of the system and that this effect should be interpreted as moderate

(f^2=0.185). With regard to the ability of the model to explain the Behavior of Use, Pearson's Determination Coefficient points to a moderate capacity (R^2=21.7%).

Regarding the explanation of Behavioral Intention, the predictive accuracy of the model was not reached (Q= -0.175), which implies that the proposed model is not able to explain this variable, based on this set of observations. Figure 3 shows the P-values of the relationships that make up the model.

Figure 3 - P-values of the relationships that make up the model.



Source: The authors.

However, the fact that only one relationship was confirmed from the collected data should not be interpreted as a definitive rejection of the theoretical model. Hair et al. (2014) state that the cause and effect relationships envisaged in structural models operationalized from the partial least squares approach are predicted to occur without systematic influences of other variables. Considering that the proposed model already envisages the existence of moderating effects exerted by the user's age and level of experience, there are previous elements that point to the existence of systematic influences of other variables in relation to the proposed model. Therefore, it was necessary to apply the multi-group analysis (MGA), as recommended by Hair *et al*. (2014).

As for the analysis procedures related to Structural Equation Modeling, given the need to evaluate the existence of moderating effects envisaged in the model, it was necessary to

perform comparison tests between groups. Therefore, in accordance to the guidelines by Hair et al (2014) and Matthews, Hair and Matthews (2018), the multi-group analysis test (PLS-MGA), which, in addition to serving as a method for detecting data heterogeneity, verifies the existence of significant differences between the path coefficients and the significance levels of the relationships, was chosen to test the existence of a statistically significant moderating effect.

Following the guidelines by Sarstedt *et al*. (2011), the first step of such procedure involves the verification of measurement invariance. Regarding the criteria for stratification of the groups to be compared, following the guidelines by Hair et al. (2014), the mean, median and the way the elements are distributed around such measures were analyzed. Considering the concern with ensuring that the sample size is sufficient to perform the statistical analyses, comparisons were established between two groups only, based on the categorization of the comparison variables. Given that the proposed model consists only of reflective constructs and that it provides for a maximum of three explanatory variables for a single construct (Intention), following the "Rule of Ten Times" (Hair et al, 2014), it is assumed that the minimum sample for each group should be made of 30 elements.

4.1 Multigroup Comparison – Experience

The first comparison between groups verified whether the Intention and Behavior of Use undergo different influences from their explanatory variables when comparing groups of users with greater and shorter times of experience using the system. Therefore, the sample was categorized considering those who have an experience of two years or less as users of "Low Experience" (n=59) and those who have more than 2 years of system use as the group of "High Experience" (n=61).

Given that both established groups have more than 30 elements, the step which follows the multi-group analysis involves verifying the power of the statistical test.

Table 6 - Statistical power of the test – Comparison by level of experience.

Endogenous Construct	High Experience		Low Experience	
	Test Power (Sig=1%)	Test Power (Sig=5%)	Test Power (Sig=1%)	Test Power (Sig=5%)
Behavioral Intention	0.982	0.997	1.0	1.0
Use Behavior	0.954	0.990	0.782	0.925

Source: The authors.

Table 6 indicates that all relationships in the model can be analyzed considering a confidence level of 99% and 95%, between both groups. The only exception occurs in the relationships that explain the Use Behavior among the Low Experience group, whose statistical test power was not confirmed for a 99% confidence level.

To verify the occurrence of measurement variances, the existence of significant differences between the factorial charges of the items used to measure each construct was observed (HAIR *et al*., 2014). From the parametric approach, it was identified that items EE1 and EE2 have statistically different charges when both groups are compared. Therefore, following the guidelines by the authors, it was necessary to exclude these two items.

Once the absence of measurement variances was ensured, the next step involved a new verification of the measurement model. Such procedure required the exclusion of an item used to measure the Use Behavior construct (US11) and an item used to measure the Intention construct (BI2), due to the low factorial charge between these items and their respective constructs.

Table 7 - Structural Model Metrics – Group Comparison – Experience Level.

	High Experience							Low Experience							MGA test Sig.
Relation	**VIF**	**CC**	**P Value**	**R^2**	**R^2 adjust.**	**f^2**	**Q^2**	**VIF**	**CC**	**Valor P**	**R^2**	**R^2 adjust.**	**f^2**	**Q^2**	
Effort Expectancy -> Behavioral Intention	3,198	-0,383	0,358	33,1%	29,5%	0,069	-0,348	2,464	0,276	0,082	65,6%	63,7%	0,090	0,538	0,205
Performance Expectancy -> Behavioral Intention	3,651	-0,224	0,364			0,020		2,837	-0,010	0,945			0,000		0,477
Social Influence-> Behavioral Intention	1,899	0,010	0,955			0,000		1,674	0,633	0,000			0,694		0,004
Behavioral Intention -> Use Behavior	1,237	-0,199	0,376	27,2%	24,7%	0,044	0,147	1,732	0,074	0,717	19,7%	16,8%	0,004	0,092	0,386
Facilitating Conditions -> Use Behavior	1,237	0,403	0,009			0,180		1,732	0,391	0,019			0,110		0,953

Source: The authors.

The interpretation of Table 7 makes it possible to affirm that the Facilitating Conditions influence the Use Behavior significantly in both groups. However, it may be noted

that, among users who have high experience, the influence of Facilitating Conditions on Use Behavior is more intense (CC=0.403 / f^2=0.180) than among those with low experience (CC=0.391 / f^2=0.110).

For users of the low-experience group, Social Influence appears as a variable that significantly influences Use Intention. This influence is significant at a 99% confidence level (sig $\leq$ 0.01) and the effect of this explanatory variable should be interpreted as strong (f^2=0.694). In addition, given that the MGA test identified a significant difference between the path coefficients of such models (sig=0.004), the empirical evidence points to the existence of a moderating effect of the Use Experience in the relationship between Social Influence and Intention to Use.

No other relationship is significant in either model, nor was there any evidence that the Use Experience moderates any other variable that makes up the model.

4.2 Multigroup Comparison - Age

The second procedure of comparison between groups and verification of the existence of moderating effects focused on the age of the interviewees. To this end, the sample was divided around the mean (39.5 years) and median (40 years) of this variable, considering those who are up to 39 years old as "Young" (n=59) and those who are 40 years old or mature as the "Mature" group (n=61).

Given that both established groups have more than 30 elements, the step which follows the multi-group analysis involves verifying the power of the statistical test.

Table 8 - Statistical power of the test – Comparison by age.

	YOUNG		MATURE	
Endogenous Construct	**Test Power (Sig=1%)**	**Test Power (Sig=5%)**	**Test Power (Sig=1%)**	**Test Power (Sig=5%)**
Behavioral Intention	1.0	1.0	0.781	0.924
Use Behavior	0.822	0.943	0.995	0.999

Source: The authors.

The reading of Table 8 shows that all relationships in the model can be analyzed considering a confidence level of 99% and 95% in both groups.

The verification of the measurement invariance from the parametric approach identified that item BI2 presents statistically different charges when both groups are compared. Thus, following the guidelines by Hair et al. (2014), it was necessary to exclude this item.

Once the absence of measurement variances was ensured, the next step involved a new verification of the measurement model. Such procedure required the exclusion of an item used to measure the Intention construct (BI1), given its low factorial charge. In addition, the discriminant validity verification stage made the exclusion of one more item (FC1) necessary.

Table 9 - Structural model metrics – Comparison between groups – Age.

	YOUNGER							MATURE							MGA test Sig.
Relation	**VIF**	**CC**	**P Value**	**R^2**	**R^2 adjust.**	**f^2**	**Q^2**	**VIF**	**CC**	**P Value**	**R^2**	**R^2 adjust.**	**f^2**	**Q^2**	
Effort Expectancy -> Behavioral Intention	3,565	0,555	0,000	69,2%	67,5%	0,280	0,602	2,611	-0,253	0,402	21,2%	17,1%	0,031	-0,681	0,751
Performance Expectancy -> Behavioral Intention	3,487	-0,258	0,092			0,062		3,343	-0,168	0,428			0,011		0,023
Social Influence -> Behavioral Intention	1,864	0,574	0,000			0,572		1,834	-0,090	0,766			0,006		0,569
Behavioral Intention -> Use Behavior	1,789	0,042	0,872	21,0%	18,2%	0,001	0,087	1,185	-0,055	0,716	34,9%	32,7%	0,004	0,160	0,730
Facilitating Conditions -> Use Behavior	1,789	0,429	0,036			0,130		1,185	0,567	0,000			0,417		0,042

Source: The authors.

The interpretation of Table 9 allows us to affirm that the Facilitating Conditions influence the Use Behavior significantly in both groups. However, it is noted that the influence of Facilitating Conditions on Behavior of Use is less intense among young people (CC=0.429 / f^2=0.130) than among the mature group (CC=0.567 / f^2=0.417). Given that a significant difference between the path coefficients in the relationship (sig=0.042) was identified in the MGA test, it can be affirmed that the empirical evidence points to the existence of a moderating effect of age on the relationship between Facilitating Conditions and Behavior of Use.

For young people, Social Influence is a variable that significantly influences Intention to Use. This influence proves significant at a 99% confidence level (sig= 0.000) and the effect of this explanatory variable should be interpreted as strong (f^2=0.572). Another significant relationship exclusively among young people occurs between Effort Expectancy and Behavioral Intention. This relationship is significant at a 99% confidence level (sig=000) and the effect of the explanatory variable should be interpreted as moderate (f^2=0.280).

Performance Expectancy is negatively and significantly related to Behavioral Intention among young people only when the 90% confidence level is assumed (sig=0.092). Among mature individuals, this relationship is not significant (sig=0.428). At this point, it is verified that the MGA test points to a moderating effect of age in the relationship between these variables (sig=0.023).

4.3 Multigroup Comparison – System Module

Having adopted an exploratory perspective of data analysis, the last operation of comparison between groups and verification of the existence of moderation effects involved the analysis of the type of system operated by the respondents. In the database analysis, 66 respondents reported using only the Build module; 37 reported using only the Quality module; 17 reported using both systems. However, given that the indicated sample for the operationalization of such a model provides for a minimum of 30 records, respondents who use both systems were excluded and the analysis was established from the comparison of respondents who use only one of each system.

Thus, the first step of the multigroup analysis involved verifying the power of the statistical test.

Table 10 - Statistical power of the test – Comparison by System Type.

	BUILD		QUALITY	
Endogenous Construct	**Test Power (Sig=1%)**	**Test Power (Sig=5%)**	**Test Power (Sig=1%)**	**Test Power (Sig=5%)**
Behavioral Intention	0.963	0.992	0.999	0.999
Use Behavior	0.996	0.999	0.432	0.696

Source: The authors.

The results of the statistical test power verifications indicate that the model generated among the users of the Build system can be analyzed considering a confidence level of 99% and 95%. Regarding the results obtained from the Quality module user group, only the relationships that precede the Behavioral Intention can be analyzed with confidence levels of 99% and 95%.

Regarding the possible biases arising from measurement variances, through the MGA test, an occurrence of invariance was verified, since no significant differences were identified between the factorial charges of the items used for measurement of each construct. Once the

absence of measurement variances was guaranteed, the next step involved a new verification of the measurement model. This procedure required the exclusion of an item used to measure the Facilitating Conditions construct (FC1), due to the low factorial charge and the low AVE assessed among the group of users of the Build module.

Table 11 - Structural model metrics – Comparison between groups – System type.

	BUILD							QUALITY							MGA test Sig.
Relation	**VIF**	**CC**	**P Value**	**R^2**	**R^2 adjust.**	**f^2**	**Q^2**	**VIF**	**CC**	**P Value**	**R^2**	**R^2 adjust.**	**f^2**	**Q^2**	
Effort Expectancy -> Behavioral Intention	3,429	-0,196	0,611	28,6%	25,2%	0,016	-,0196	2,349	0,364	0,025	65,5%	62,3%	0,163	0,565	0,839
Performance Expectance -> Behavioral Intention	4,088	-0,355	0,118			0,043		2,241	0,093	0,615			0,011		0,290
Social Influence -> Behavioral Intention	1,740	-0,007	0,979			0,000		2,230	0,438	0,009			0,249		0,991
Behavioral Intention -> Use Behavior	1,158	-0,118	0,557	34,1%	32,0%	0,018	0,183	1,907	-0,185	0,493	18,2%	13,4%	0,022	0,068	0,180
Facilitating Conditions -> Use Behavior	1,158	0,530	0,000			0,367		1,907	0,533	0,005			0,182		0,231

Source: The authors.

The type of system used by the respondents does not act as a moderating variable for any of the relationships envisaged in the model. However, when comparing the models between the two groups, it is observed that, while only the relationship between Facilitating Conditions and Behavior of Use can be considered significant among the users of the Build System (sig=0.000), there are three significant relationships among the users of the Quality module.

The Effort Expectancy influences positively (CC=0.364) and significantly (sig=0.025) the Behavioral Intention, with an intensity that can be considered moderate (f^2=0.163).

Social Influences are related positively (CC=0.438) and significantly (sig=0.009) to Behavioral Intention. Said influence must be interpreted as moderate (f^2=0.249).

Finally, the Facilitating Conditions influence the Use Behavior positively and significantly, for users of the Build module (CC=0.530 / sig=0.000) and users of the Quality module (CC=0.533 / sig=0.005) alike. However, while the intensity of the explanatory variable's influence on the explained one should be interpreted as strong (f^2=0.367) among the users of the Build module, this effect should be interpreted as moderate among the Users of the Quality module (f^2=0.182).

4.5 Summary of the results obtained

To confirm or reject the established hypotheses, it is ideal to consider the results obtained from every interviewee, but also the results obtained from each group of elements. For this, a significance level of 5% and a confidence level of 90% were adopted, considering the exploratory characteristic of the study. The results are presented in Table 12.

Table 12 - List of Rejected and Supported Hypotheses.

ID	HYPOTHESES	RESULTS	CONCLUSION
H1	Performance Expectancy positively influences Behavioral Intention.	No significant relationship	Rejected
H2	Effort Expectancy positively influences Behavioral Intention.	Significant relationship between Young People and Users of the *Quality* module	Supported
H3	Social Influence positively influences Behavioral Intention.	Significant Relationship between Low Experience, the Young, and Users of the *Quality* module	Supported
H4	Facilitating Conditions positively influence Behavioral Intention.	Significant relationships across all models	Supported
H5	Behavioral Intention positively influences Use Behavior.	No significant relationship	Rejected
H6	Age has a moderating effect on the relationship between Performance Expectancy and Behavioral Intention.	Significant MGA test	Supported
H7	Age has a moderating effect on the relationship between Effort Expectancy and Behavioral Intention.	Non-significant MGA test	Rejected
H8	Age has a moderating effect on the relationship between Social Influence and Behavioral Intention.	Non-significant MGA test	Rejected
H9	Age has a moderating effect on the relationship between Behavioral Intention and Use Behavior.	Non-significant MGA test	Rejected
H10	Age has a moderating effect on the relationship between Effort Expectancy and Behavioral Intention.	Non-significant MGA test	Rejected
H11	Experience has a moderating effect on the relationship between Social Influence and Behavioral Intention.	Significant MGA test	Supported
H12	Experience has a moderating effect on the relationship between Behavioral Intention and Use Behavior.	Non-significant MGA test	Rejected

Source: The authors.

For users in the Young group, Effort Expectancy appears as a variable that influences Behavioral Intention. This relationship is significant, with a confidence level of 99% (sig=000) and the effect of the explanatory variable on the one explained should be interpreted as moderate (f^2=0.280). H2 is supported.

For users in the low-experience group, Social Influence appears as a variable that significantly influences Use Intention. This influence is significant at a 99% confidence level (sig $\leq$ 0.01) and the effect of this explanatory variable should be interpreted as strong (f^2=0.694). In addition, given that the MGA test identified a significant difference between the

path coefficients of such models (sig=0.004), the empirical evidence points to the existence of a moderating effect of the Use Experience in the relationship between Social Influence and Intention to Use. H3 is supported.

The only significant relationship is the one between Facilitating Conditions and Use Behavior (sig=0.000). Thus, the greater the Facilitating Conditions, the greater the use of the system. This effect must be interpreted as moderate (f^2=0.185). With regard to the ability of the model to explain the Behavior of Use, Pearson's Determination Coefficient points to a moderate capacity (R^2=21.7%). This means that Facilitating Conditions positively affect the MES Use Behavior. H4 is supported.

Another significant relationship exclusively among young people occurs between Effort Expectancy and Behavioral Intention. This relationship is significant, with a confidence level of 99% (sig=000) and the effect of the explanatory variable on the explained one should be interpreted as moderate (f^2=0.280). H6 is supported.

For users in the low-experience group, Social Influence appears as a variable that significantly influences Use Intention. This influence is significant, with a 99% confidence level (sig $\leq$ 0.01). The effect of this explanatory variable should be interpreted as strong (f^2=0.694). In addition, given that the MGA test identified a significant difference between the path coefficients of such models (sig=0.004), the empirical evidence points to the existence of a moderating effect of the Use Experience in the relationship between Social Influence and Intention to Use. H11 is supported.

Regarding the interpretation of the verified results, there is an advocation for its interpretation as a verification of the capacity of the theoretical model tested to explain the intention and behavior of use within the public and the facility of analysis selected – in this case, the Stellantis facility in the city of Betim. In this sense, it is important to interpret the results as a reflection of how these actors relate to the system used, in the specific context of the analyzed company.

The findings of the meta-analysis by Khechine, Ndjambou, and Lakhal (2016) confirmed the strength and robustness of the UTAUT model as an explanatory model for the acceptance and use of Information Systems (IS) and Information Technology (IT). When considering the intention to use IS/IT, the UTAUT model has a solid theoretical basis, as three of the four variables (performance expectancy, effort expectancy and social influence) have been shown to positively influence the behavioral intention to use IS/IT. When

considering use behavior, one of the two explanatory constructs (behavioral intention) proved to directly affect the use behavior of new IS/IT. These results mean that 80% (4/5) of the main relationships of the UTAUT model originally tested by Venkatesh *et al*. (2003) have been validated in many contexts by different scholars.

Alam and Uddin (2018) used the UTAUT model to explore the intention to use Enterprise Resource Planning (ERP) in Bangladeshi companies. The questionnaire was responded by 201 executives who worked with operation management at several manufacturing companies, and the results indicate that the Performance Expectancy (PE) has a positive relationship with Behavioral Intention (BI), which means that people who are using the system believe that it will increase their performance. In addition, Facilitating Conditions (FC) have been found to positively influence Behavioral Intention (BI), meaning that when employees receive better infrastructure support to use ERP, they use it more frequently. These data are consistent and corroborate the findings of Venkatesh *et al*. (2003), who also verified a positive influence of Social Influence (SI) upon Behavioral Intention (BI).

To understand the factors which affect the adoption and use of the customized ERP system for Jordanian universities, Althunibat *et al* (2019), using the UTAUT model, sent 500 questionnaires to university professors and managers. Among the responses received, 220 questionnaires were validated and the results indicate that Social Influence (SI) has the greatest influence on adoption and positively affects the user's Behavioral Intention (BI) in the acceptance and use of ERP.

Chauhan and Jaiswal (2016) used UTAUT to investigate the acceptance factors of SAP ERP software used in Indian business schools. The survey data were collected from 324 business students and the results revealed that the Performance Expectancy (PE) and the Effort Expectancy (EE) positively affect the Behavioral Intention (BI) of the students, as it also occurred with the Facilitating Conditions (FC).

6. CONCLUSION

With the aid of the literature review and the results of the quantitative analysis, it was possible to identify the factors that affect the users' acceptance towards the Manufacturing Execution System (MES) in the Stellantis production facility in Betim, through the application of the model of the Unified Theory of Acceptance and Use of Technology

(UTAUT), incorporating four dimensions: performance expectancy, effort expectancy, social influence and facilitating conditions.

The performance expectancy dimension is the degree to which an individual believes that system use will help them achieve gains in job performance. The effort expectancy dimension is defined as the degree of ease associated with the use of the system. The social influence dimension is the degree to which an individual realizes that other important individuals believe that he or she should use the new system. Enabling Conditions are defined as the degree to which an individual believes that there is an organizational and technical infrastructure to support the use of the system. As a result, the study consisted of verifying whether these factors have a positive effect on system users' behaviors or not, according to their specificities.

The findings showed which factors influence the use of the system. It was possible to verify that the Facilitating Conditions influence the users' Use Behavior. The application of the MGA, as recommended by Hair *et al.* (2014), showed that the Effort Expectancy positively influences the Behavioral Intention in the group of Young users and users of the Quality module, and that Social Influence also positively influence the Behavioral Intention of the group of young users, users with low experience and those who make use of the Quality module.

Research indicates which factors may affect user behavior in system use. In relation to this study, an important contribution is the identification of users' acceptance factors, especially considering the influence of Facilitating Conditions on Use Behavior. In addition, the comparison between groups of users, through the moderating variables Age and Experience, made it possible to demonstrate the influence of Effort Expectancy and Social Influence on the Behavioral Intention of users.

Considering that the UTAUT model already envisages the existence of moderating effects exerted by the user's age and level of experience, there are previous elements that point to the existence of systematic influences of other variables in relation to the proposed model. Therefore, it was necessary to apply the multi-group analysis (MGA), as recommended by Hair *et al*. (2014).

Another important contribution is that this study proposes a new model, based on the UTAUT model, through the application of the MGA. The most important implication was the identification of which factors, through the UTAUT model, influence the use of the MES. In

this sense, it is important to emphasize the pioneering nature of the study, since no research was found on academic bases that address the use of UTAUT with the MES system.

On the other hand, it should be recognized that the context in which the model was tested does not correspond faithfully to its structure, considering that the respondents are already users of the system and that such use occurs involuntarily, being established by the company. In this sense, it is important to recognize that the expectation measuring constructs, in fact, were measured among users who already have experience with the system, which means they are closer to a post-use evaluation than to a projection of the future (expectation).

Still in relation to this reality, it should be recognized that the studies that establish the relationship between intentions and behaviors, according to the Theory of Planned Behavior or the Theory of Rational Action, generally start from the assumption that such behaviors are a choice made by the individual. This fact may explain the absence of a relationship between Behavioral Intention and Behavior of Use in every model tested.

Thus, more research should be carried out to compare, understand and explain in more detail the factors that influence the levels of use and acceptance towards the manufacturing execution system in companies from different industrial segments.

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APPENDIX

APPENDIX A - Analysis – Descriptive Statistic Univariate of all items envisaged to measure the theoretical constructs in the model.

Code	N	Mín.	Max.	Aver.	Standard Deviation	Variance	Asymmetry	Kurtosis
BI1	120	2,44	7,00	6,466	0,927	0,860	-2,148	5,231
BI2	120	2,33	7,00	6,447	0,961	0,924	-2,177	5,193
BI3	120	2,84	7,00	6,432	0,863	0,744	-1,742	3,033
BI4	120	2,68	7,00	6,397	0,903	0,816	-1,680	2,687
EE1	120	1,00	7,00	5,600	1,266	1,603	-1,252	2,258
EE2	120	1,00	7,00	5,660	1,293	1,672	-1,424	2,801
EE3	120	1,00	7,00	5,630	1,437	2,066	-1,420	2,185
EE4	120	1,00	7,00	5,620	1,409	1,986	-1,451	2,429
FC1	120	1,00	7,00	5,660	1,411	1,992	-1,232	1,329
FC2	120	1,00	7,00	5,370	1,366	1,867	-1,050	1,375
FC3	120	1,00	7,00	4,570	1,828	3,340	-0,058	-1,182
FC4	120	1,00	7,00	5,640	1,235	1,526	-1,026	1,093
PE1	120	1,00	7,00	5,850	1,241	1,540	-1,561	3,224
PE2	120	1,00	7,00	5,340	1,596	2,546	-1,170	1,094
PE3	120	1,85	7,00	6,306	1,046	1,094	-2,231	6,281
PE4	120	1,16	7,00	6,053	1,211	1,466	-1,926	4,607
SI1	120	1,00	7,00	5,770	1,454	2,113	-1,420	1,885
SI2	120	1,00	7,00	6,050	1,437	2,065	-1,904	3,396
SI3	120	1,58	7,00	6,163	1,124	1,263	-1,544	2,301
SI4	120	1,00	7,00	5,730	1,576	2,483	-1,541	1,913
US1	120	1,00	7,00	4,350	2,318	5,372	-0,378	-1,440
US2	120	1,00	7,00	4,240	2,355	5,546	-0,295	-1,517
US3	120	1,00	7,00	5,590	1,647	2,714	-1,306	1,060
US4	120	1,00	7,00	4,990	2,006	4,025	-0,757	-0,597
US5	120	1,00	7,00	5,320	1,829	3,344	-0,908	-0,197
US6	120	1,00	7,00	4,930	1,928	3,717	-0,708	-0,614
US7	120	1,00	7,00	4,920	2,052	4,211	-0,705	-0,767
US8	120	1,00	7,00	4,870	2,126	4,520	-0,708	-0,851
US9	120	1,00	7,00	5,460	1,791	3,208	-1,171	0,330
US10	120	1,00	7,00	4,500	2,185	4,773	-0,396	-1,240
US11	120	1,00	7,00	3,360	2,141	4,585	0,306	-1,343
US12	120	1,00	7,00	3,620	2,227	4,961	0,123	-1,520
US13	120	1,00	7,00	3,210	2,157	4,654	0,415	-1,277
US14	120	1,00	7,00	3,820	2,355	5,546	-0,016	-1,623

Source: The authors.