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Abstract. In the age of the fourth industrial revolution, the competition between Small and Medium-sized Enterprises (SMEs) is fierce to operate efficiently and hold on to their customers. Due to lack of time and methodology, SME leaders are struggling to establish optimized strategies for their businesses. One way is by using dashboards that will proactively help to collect data, make decisions, facilitate the strategy implementation and keep the employees focused. This article aims at determining the suitability of the Technology Acceptance Model to the design of risk analysis dashboard and examining the influence between the model constructs.

Keywords: Technology Acceptance Model, Dashboard, SME, Partial Least Squares

1 Introduction

In the age of the fourth industrial revolution, Small and Medium-sized Enterprises (SMEs) are competing to improve their efficiency while retaining the interests of their customers. Unfortunately, many SME leaders have difficulties in establishing an optimized and coherent strategy due to lack of time, methodology and / or know-how. Too often, they react to changes in the environment by taking short-term actions, without worrying too much about their relevance to the overall strategy, or the consequences that such decisions can have on the future development of their business. Also, the growth of a business depends on its ability to identify and adapt to its environment risks, and then continuously measuring the performance of its key processes. However, this approach has little impact on a company's profitability unless employees interact with its performance dashboards and take actions based on the data collected (Grant, 2016), (Velcu-Laitinen, 2012). Hence, a good fit between the dashboard design features, its ease of use and its usefulness, should generate a positive predisposition among its users. The Technology Acceptance Model (TAM) has been used extensively in the last decades as the success of a new technology can be determined by its user acceptance, measured by three constructs: Perceived Usefulness (PU), Perceived Ease of Use (PEOU), and Attitude Towards Usage (ATU) of the system (Davis, 1989). Therefore, the purpose of this study is (i) to examine the relationship of employee' behavioural intention to use a risk analysis dashboard with the above constructs; and (ii) to develop a general model of risk analysis dashboard acceptance.

From these observations, emerged the following research question: *Does the Technology Acceptance model is appropriate to analyse the employees' behavioural intention to use a risk analysis dashboard?* In pursuit of this aim, this paper introduces the concept of dashboard, then presents the Technological Acceptance Model (TAM) with its relevance to the design of dashboard. The proposed research model is introduced, followed by the research methodology, data analysis, results and research findings. Finally, this paper concludes by pointing out the future research directions.

2 Outline

2.1 Dashboard

The term dashboard comes from the dashboard of a vehicle as it presents the metrics that the driver needs to know. Similarly, dashboards also presents information from which managers and employees can visually identify trends, patterns and anomalies about the company (Yigitbasioglu and Velcu, 2012). Dashboards have three fundamental purposes: to monitor critical activities and processes using metrics that trigger alerts when performance falls short of established goals, to analyse the root causes of problems by exploiting relevant and timely data, to manage people and processes to improve decisions and lead the organization in the right direction (Eckerson, 2011). According to Tezel, the use of visual tools in a SME has multiple benefits such as improving transparency, facilitating routine job tasks, influencing people's behaviours, fostering continuous improvement, creating shared ownership, supporting management by facts, and removing organisational boundaries (Tezel et al., 2016).

2.2 Dashboard Design Features

(Bititci et al., 2016) presents a classification for dashboards, depending on the level (strategic or operational) and the theme (planning or progress). Dashboard are characterised by two types of design features: functional and visual features. Functional features allow a cognitive adjustment with different types of users, while the visual features refer to how efficiently and effectively information is presented to the user. Table 1 summarizes the dashboard design features identified in the literature (Abduldae and Gravell, 2019), (Yigitbasioglu and Velcu, 2012), (Brandy et al., 2017), (Rahman et al., 2017).

Table 1. Summary of Dashboard Design Features

Functional features	**Visual features**

Drill-down capabilities	Display information on a single page
Scenario analysis	High data to ink ratio
Real-time notifications and alerts	Use of grid lines for 2D and 3D graphs
Format type (graphs vs tables)	Frugal use of colours (prefer intensity) and keep graphical icons sparse
Format flexibility and interactivity (to be able to display data in various formats and at different levels of aggregation)	Improve the context of metrics (performance state, trend and variance)

2.3 Technology Acceptance Model (TAM)

Technology Acceptance Model (TAM) was introduced by Fred Davis in 1986 and it is specifically tailored for modeling users' acceptance of information systems or technologies. Dashboards can be designed in a variety of ways, in our case the user wants to get specific piece of information about the results of the risk analysis and uses the dashboard to obtain it. As a result, the design and the visualization style must respond to some aspects of TAM (Janes et al., 2013). TAM is built on the Theory of Reasoned Action, positioning Perceived Usefulness (PU) and Perceived Ease Of Use (PEOU) as the main determinants of Behavioural Intention to Use (BIU) and Attitude Towards Usage (ATU) (as shown in Figure 1). Perceived Usefulness is defined as "the degree to which a person believes that using a particular system would enhance his or her performance" (Davis et al., 1989). Perceived Ease Of Use refers to "the degree to which a person believes that using a particular system would be free of effort" (Davis et al., 1989). PU and PEOU have demonstrated high reliability, validity (Venkatesh, 1996) and have received empirical support for being robust in predicting technology adoption for a variety of technologies such as ERP, e-book, smartwatch, E-payment, driving assistance systems or Dashboard Design (Janes et al., 2013).
TAM proposes that a higher level of PU and PEOU will lead to a higher level of positive Attitude Towards Usage (ATU) of that system, which finally indicates a higher degree of Behavioural Intention to Use (BIU) the system (Davis et al., 1989). Attitude Towards Usage refers to the "degree to which an individual evaluates and associates the target system with his or her job", while Behavioural Intention to Use is a "measure of the strength of one's intention to perform a specified behaviour" (Scholtz et al., 2016).

The literature review has revealed that the evaluation of dashboard using the Technology Acceptance Model is scarce (Rahman et al., 2017) hence the need to identify if the TAM framework is an appropriate tool for assessing employee's acceptance of a risk analysis dashboard (Vasnier et al., 2020).

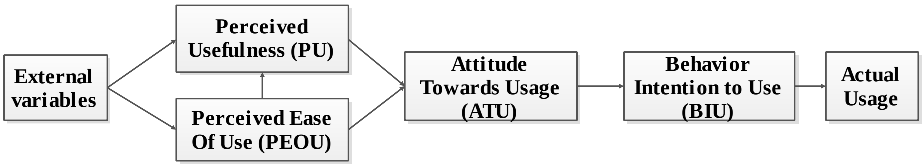

Fig. 1. Technology Acceptance Model (Davis et al., 1989)

3 Proposed Research Model and Hypotheses

In this section, we propose a research model that will analyse the employees' behavioural intention to use a risk analysis dashboard through the Technology Acceptance Model. In accordance with the research objectives and consistent with the related literature, this study examined the following hypotheses:

- H1: Dashboard Design Features positively affects Perceived Usefulness
- H2: Dashboard Design Features positively affects Perceived Ease Of Use
- H3: Dashboard Design Features affects Attitude Towards Usage
- H4: Perceived Usefulness positively affects Attitude Towards Usage
- H5: Perceived Ease of Use positively affects Attitude Towards Usage
- H6: Attitude Towards Usage has a positive affects on the Behavioural Intention to Use a risk analysis dashboard

Based on the Technology Acceptance Model (TAM), we derived our research model as shown in Figure 2. The general hypothesis is that the Dashboard Design Features (DSF) have an impact on PU, PEOU and ATU of a risk analysis dashboard, which should indicates a strong impact on the Behavioural Intention to Use (BIU).

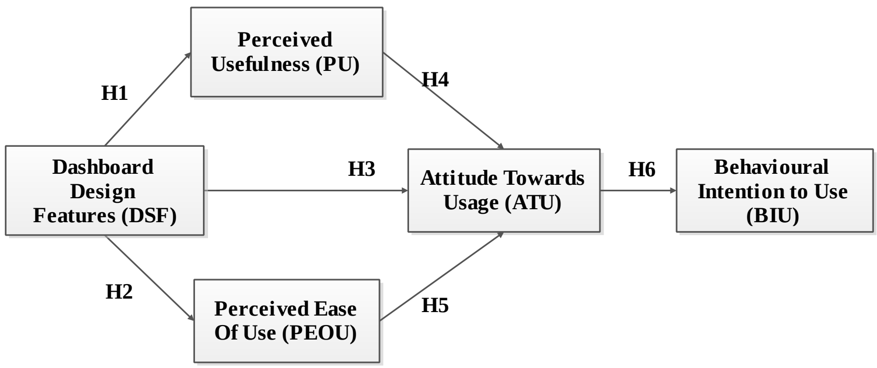

Fig. 2. Proposed Research Model

4 Case Study

4.1 Questionnaire Design

An internet-based survey[1] was conducted to explore the Attitude Towards Usage and Behavioural Intention to Use of a risk analysis dashboard. To limit the self-selection bias and conflict of interest, the survey was distributed to several groups of executives enrolled in postgraduate programmes (n=90). A response rate of 57% (n=51) was ob-

[1] https://forms.gle/b43Eo5PMM92PA9iV7

tained (89% male, 11% female) with a mean age of 34 years (σ≈9 years). All respondents completed the survey based on the survey items shown in Table 2 and a proposed risk analysis dashboard (Figure 3). This dashboard was derived from brainstorming activities carried out by a group of 14 mature students enrolled in a Master of Engineering (MEng) programme (86% male, 14% female) with a mean age of 37 years (σ≈7.5 years). This dashboard display the results of an assessment made by a SME management team on the impact of environment risk factors (either threats or opportunities) to the main strategic dimensions (Vasnier et al., 2020).

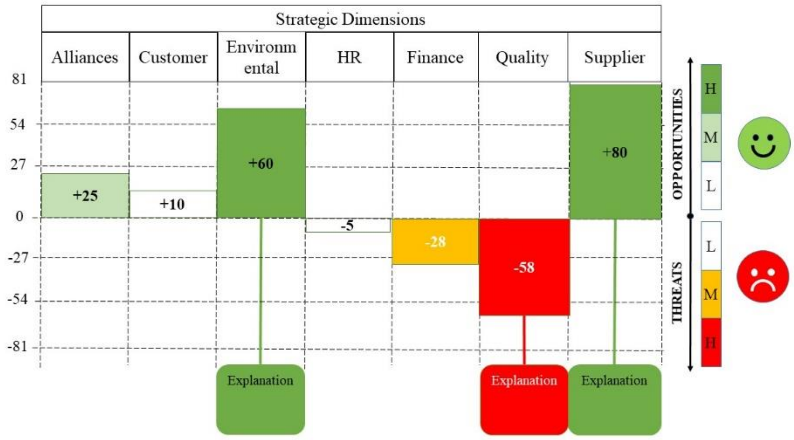

Fig. 3. The Proposed Risk Analysis Dashboard

The survey items are designed to capture the five constructs in the Proposed Design Dashboard Model (Figure 2): Dashboard Design Features (DSF), Perceived Usefulness (PU), Perceived Ease Of Use (PEOU), Attitude Towards Usage (ATU) and Behavioural Intention to Use (BIU). Table 2 shows the grouping of the items under each construct. The TAM questionnaire was derived from (Davis et al., 1989), (Surendran, 2012), (Scholtz et al., 2016) and the Dashboard Design Features originated from the recommendations of Table 1.

Table 2. TAM questionnaire

Construct	**Items**	**Survey items**
Perceived Usefulness (PU)	PU1	This dashboard is effective in presenting the threats and the opportunities?
	PU2	Does the dashboard increase employee collaboration?
	PU3	The dashboard makes it possible to limit misunderstandings between the management and the employees?
	PU4	Does the dashboard increase the efficiency of employees?
	PU5	Overall, I find that the dashboard is useful?
	PEOU1	The dashboard is easy to understand and interpret?
	PEOU2	The interaction with the dashboard is simple and clear?

Perceived Ease of Use (PEOU)	PEOU3	The dashboard is easy to learn?
	PEOU4	The use of the dashboard requires little effort?
	PEOU5	Overall, the dashboard is easy to use?
Dashboard Design Features (DSF)	DSF1	Do the scores are prioritized?
	DSF2	Do the highest and lowest scores are explained?
	DSF3	Does each score is quantify by a number, a letter or other?
	DSF4	Does each score is strengthened by visual elements?
	DSF5	Does each score is interpretable using a global scale?
Attitude Towards Usage (ATU)	ATU1	I have a favourable attitude toward using those dashboards?
	ATU2	It will be a good idea to use these dashboards in my company?
	ATU3	Overall, I enjoyed using those dashboards?
	ATU4	I like the idea of using those dashboards?
Behavioural Intention to Use (BIU)	BIU1	I intend to use those dashboards in the future?
	BIU2	I intend to use those dashboards as often as possible?
	BIU3	I will recommend the use of those dashboards to my colleague?
	BIU4	If I had those dashboards in my company, I will adjust my priorities according to the information displayed?

All items were measured using a labelled seven-point Likert scale: Responses were coded from 1 (for ‘Strongly Disagree’) to 7 (for ‘Strongly Agree’), so higher ratings indicated more positive attitudes.

4.2 Data Analysis and Results

The SmartPLS Version 3.0 software was used to analyse the data gathered from the survey. SmartPLS is one of the prominent software applications for Partial Least Squares Structural Equation Modeling (PLS-SEM). It has been deployed in many fields, such as behavioural sciences, marketing, business strategy and building information modelling (Enegbuma et al., 2015). Following the recommendations by other researchers (Chin, 2010) the bootstrapping method (500 subsamples) was used to determine the significance levels of loadings, weights, and path coefficients.

The minimum sample size was identified at n=55 by using the G*Power calculator with the setting as follows: effect size: $f^2 = 0.15$ (medium), $\alpha = 0.05$, number of predictors = 3 and a statistical power of 80% (Kwong and Wong, 2013). The descriptive statistics of the five-construct items highlighted that all means are above the midpoint of 3.00 and the standard deviations ranged from 0.949 to 1.947.

Table 3. First-order Constructs’ Reliability and Validity

Constructs	**CR**	**AVE**
Perceived usefulness (PU)	0.896	0.635
Perceived ease of use (PEOU)	0.947	0.782
Dashboard design features (DSF)	0.760	0.397
Attitude Towards Usage (ATU)	0.971	0.894
Behavioural Intention to Use (BIU)	0.957	0.847

The Average Variance Extracted (AVE) and Composite Reliability (CR) measures of the five first order constructs are reported in Table 3. The measurements are acceptable if the AVE for each construct is greater than 0.50 and CR is greater than 0.70 (Hair et al., 2012). In this case, all items are loaded highly on their own latent variable, and thus all measurements have satisfactory levels of reliability.

The analysis of discriminate validity (Table 4) indicates a reasonably higher loading of each item on its intended construct than on any other constructs, to the exception of the very high correlation between DSF and PEOU (0,634), ATU and BIU (0,868). The calculation yielded Variation Inflation Factor (VIF) of 1.000 for both cases, which is less than 5. Therefore, it is confirmed that no multicollinearity exists among the constructs (Hair et al., 2011).

Table 4. Discriminate validity of first order constructs (Note: The diagonal represents the square root of AVE while the others entries represent le squared correlations)

	ATU	BIU	DSF	PEOU	PU
ATU	0.945				
BIU	0.868	0.920			
DSF	0.538	0.416	0.630		
PEOU	0.359	0.194	0.634	0.884	
PU	0.499	0.383	0.532	0.632	0.794

This study employed a structural equation modeling approach to develop a model that represents the relationships among the five constructs in this study: Perceived Usefulness (PU), Perceived Ease Of Use (PEOU), Dashboard Design Features (DSF), Attitude Towards Usage (ATU) and Behavioural Intention to Use (BIU) (Figure 4).

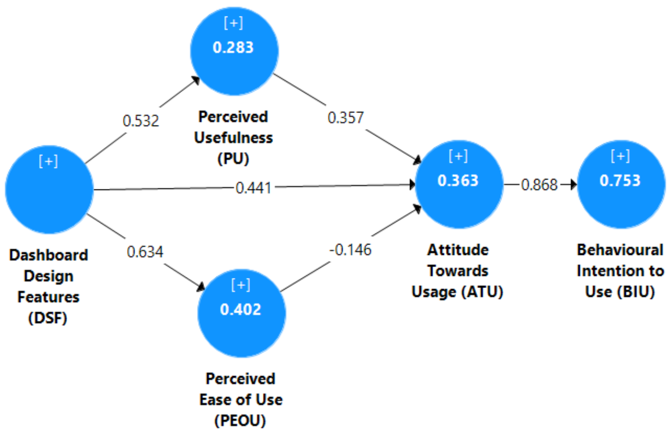

Fig. 4. Results of the Proposed Research Model (from SmartPLS)

Table 5 presents the results of the hypotheses tests by confirming the presence of statistically significant relationship in the predicted axis of the proposed research model.

Table 5. Hypotheses Testing Results

Hypothesis	Relation	Path co-efficient	t value	p value	Result
H1	DSF → PU	0.532	6.436	0.000	supported
H2	DSF → PEOU	0.634	7.546	0.000	supported
H3	DSF → ATU	0.441	2.417	0.016	supported
H4	PU → ATU	0.357	3.165	0.002	supported
H5	PEOU → ATU	-0.146	0.655	0.512	not supported
H6	ATU → BIU	0.868	17.651	0.000	supported

Strong and statistically significant evidence were found in support of hypotheses H4 (β= 0.357, p<0.01) and H3 (β= 0.441, p<0.01). In addition, the results revealed that ATU strongly influences the users' BIU of risk analysis dashboard, with H6 (β= 0.868, p<0.01) being supported. Hypothesis H2 (β= 0.634, p<0.01) is supported which addresses the positive impact of the dashboard design features on PEOU. Statistically, significant support is found for H1 (DSF → PU, β=0.532, P<0.01), and this confirms previous studies reporting a positive effect of DSF on PU (Vasnier et al,. 2020). However, H5 (PEOU → ATU, β=-0.146, P>0.05) is not supported.

4.3 Findings and Discussion

The purpose of this study was to determine if the Technological Acceptance Model could be applied to the field of risk analysis Dashboard by examining the relationship between the five constructs: DSF, PU, PEOU, ATU and ultimately BIU.

- Consistent with prior research, PU has a significant effect on ATU. An explanation might be that when user perceive the risk analysis dashboard as one that is useful for their work, they have a positive attitude towards the usefulness of the tool.
- An interesting outcome of this research is the fact that the Dashboard design features have a strong effect on the Attitude Towards Usage of a risk analysis dashboard.
- The impact of PEOU on ATU was not found significant. This result is in correlation with the findings of Ramayah (Ramayah et al., 2017). This finding can be possibly attributed to the profile of the respondents that consists of mature and educated postgraduates. Presumably, the Perceived Usefulness and Dashboard Design Features are more critical to them than Perceived Ease of Use as they are decision makers.
- Hypothesis H2 is supported, i.e. the Dashboard Design Features (DSF) have a strong positive effect on PEOU.
- Furthermore, the role of ATU was found major in predicting the Behavioural Intention to Use a risk analysis dashboard. This provides support to the idea that the employees will use a risk analysis dashboard that is found useful and well designed.

5 Conclusion

This preliminary study has made several theoretical contributions to the use of the Technology Acceptance Model in the field of strategic dashboard application. Mainly, the statistical analysis validate the research question: Does the TAM is appropriate to analyse the employees' behavioural intention to use a risk analysis dashboard? It is interesting to note that the study showed that Attitude Towards Usage of a risk analysis dashboard is positively affected by the Perceived Usefulness and the Dashboard Design Features. Specifically, it identifies the strong influence of the construct Attitude Towards Usage towards the Behavioural Intention to Use a risk analysis dashboard. The "voice of the workers" in term of opinions about the design and use of a risk analysis dashboard was not the focus of this article. As a result, further research is required in assessing the workers' point of view, thus avoiding possible bias of employees from middle and top levels of management.

Finally, some further investigation are required to identify the strong effect of DSF on ATU by expanding the number of items investigated in the panel of functional and visual characteristics of a dashboard. Risk analysis dashboards sit at the crossroads of strategy formalization, data-capture, and decision-making. Carefully designed and deployed risk analysis dashboards can provide incisive strategic insight and enhance the alignment between the SME's strategy, its people, its organization and its processes.

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