# Behavior of Organizational Agents on Managing Information Technology

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| Keywords (separated by '-') | Information technology - Theory of planned behavior - Project portfolio management - Life cycle management - Project management - Benefits management |

# Behavior of Organizational Agents on Managing Information Technology

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**Abstract.** Improving the impact of information technology (IT) investments is potentially beneficial for our society. This study identifies triggers which influence behavior of organizational agents on managing IT. In scope of this study are the portfolio decisions regarding where to invest the IT euro, the management of IT projects and the management of the IT infrastructure. Following the theory of planned behavior, it is shown for controllers of Dutch organizations that 'intention' is positively associated with behavior and that 'subjective norm' and 'perceived behavior control' are positively associated with intention. For portfolio and IT infrastructure management, attitude is also positively associated with intention. Overall it is concluded that the most important levers for behavior for the focus areas are 'social pressure' and the explicit confirmation of the agent's own intention. This is good news since both can be easily influenced without significant monetary investment.

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## 1 Introduction

IT is highly relevant in our current society since IT spending will be an estimated $3.7 Trillion in 2018 [1], while in 2000 Strassmann [2] found that 55% of the US workforce were devoted to information creation, distribution and consumption. Unfortunately, no more recent numbers could be found but it seems safe to assume that this percentage has grown over the past 17 years, given that even those with non-standardized and difficult to automate jobs spend 47% of their time on email as well as on tracking down information needed for their tasks [3]. In 2015 an estimated 90% of the jobs in the EU required at least basic computer skills [4] and it looks like Davenport's statement [5] that "all of us are information managers"–grows more accurate on a daily basis.

Against this backdrop, the digital transformation revolutionizes existing industries and creates new ones [6, 7]. Such a transformation is driven by developments such as mobility, social media, big data and cloud computing [8, 9] which change the way information is received, processed and managed.


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Given the resources allocated to IT and information processing, as well as the impact of digital transformation, significant monetary benefits are achievable when the bang for an IT buck improves (comp. [10–15]). Three interesting and important areas for improving IT impact are studied in this paper. They are seen as important because large upswing potentials are expected for each of them; the three differ significantly to one another and together cover a significant part of managing IT. The first focus is on where to invest the IT euro since not all IT investments are equally successful. Although 60% of the post calculated IT investments delivered more than 80% of the expected value, 13% of them in the 2015 study diminished the value of the organization [16]. The second focus is on the implementation of IT investment. Not all IT projects are delivered according to expectation [17] and some even threaten the existence of an organization [18]. The third focus is on the usage of the existing IT infrastructure. This is relevant as 50–90% of the total cost is a result of maintenance cost [19, 20].

Within these three focus areas, this paper studies the IT related behavior of the people working in organizations, i.e. organizational agents [21], so that we can better understand how they work in organizations, make IT-related decisions and how they act in relation to IT. The research question is:

*What influences the behavior of organizational agents in managing information technology?*

This paper discusses the theoretical foundations and associated hypotheses. Then the research method is outlined and results are presented. Finally, the paper concludes with a discussion of the research.

## 2 Theory and Hypotheses

This paper conceptualizes three focus points within IT management: (I) deciding where to invest, (II) projects in which IT-investment is implemented and (III) the usage of the IT infrastructure. The focus areas are closely interlinked and together can be defined as a process model with three sub-processes. The first two, project portfolio management and project management, are dominated by scoping, creating and changing the IT capabilities such as processes, procedures and information systems, whereas the third sub-process–lifecycle management–is focused on using those capabilities.

In Portfolio Selection, Markowitz [22] describes a theory which selects securities in order to create a balanced portfolio to protect against risks whilst optimizing return. His theory aims at achieving an ‘efficient portfolio’ meaning that it is impossible to obtain a greater return without incurring a greater standard deviation (risk) or that it is impossible to obtain a smaller standard deviation without giving up return. The theory Markowitz developed is also studied and used for managing IT investment portfolios [20, 23–28]. In this paper all activities performed to optimize information technology impact by allocating IT budgets to individual project calls are called project portfolio management (PPM).

The implementation of IT investments is usually organized into projects. Project management (PM) is the second sub-process and covers all activities which optimize

the value generated by IT by delivering the IT investments prioritized by PPM. The relative success of PM depends on efficiency and plan accuracy. Efficiency is defined as delivering project output as fast as possible while sacrificing as few resources as needed [29, 30] whereas plan accuracy is defined as delivering the required quality on time and within budget [17].

The output of an IT project normally comprises a new or an enhanced IT infrastructure. The third sub-process, life cycle management (LCM), leverages this IT infrastructure and includes all activities which optimize IT impact by improving the usage of the extant IT infrastructure (comp. [31]). Its ultimate goal is 'technical efficiency' [32] where the maximum output is generated from the extant technology.

The three sub-processes are in the scope of this study and work closely together as PM is fed with project calls from PPM and as LCM receives upgraded IT infrastructure from PM. They can all produce waste and value is only generated by the usage of the infrastructure in the LCM sub-process. All three sub-processes give feedback on their functioning; the feedback of LCM on the usage and effects of the IT assets can be used to optimize PPM and PM. The feedback on the plan accuracy of PM can be used to optimize PPM. An overview of the three sub-processes including their main inputs and outputs is presented in Fig. 1.

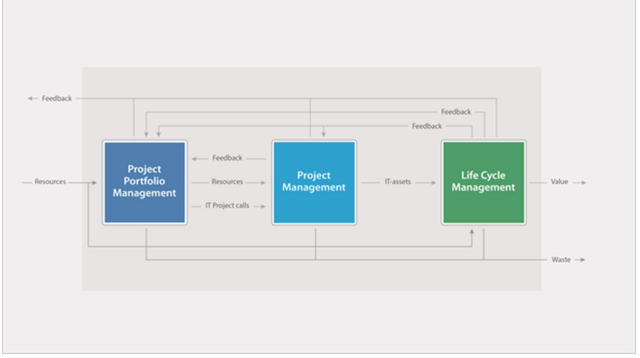


**Fig. 1.** The main inputs and outputs of the three subprocesses.

Yet the management of IT not only requires technical knowledge and skills, it also is determined by human behavior [33–35]. Human decisions and actions directly influence the performance of all three sub-processes. In 1991, Ajzen [36] published a social behavioral model called the theory of planned behavior (TPB). His theory was confirmed by numerous empirical studies [37] and has also been applied successfully in the business domain [10, 38–44]. Within the IT discipline, the theory has been employed several times [45–53]. In this study, the TPB model is tested in relation to the three sub-processes.

According to the TPB model, intention predicts behavior and states that there is a high probability a human being actually does what she intends to do. Thus, the intention to work on one of the sub-processes is expected to be a predictor for actually working on them. Yet 'it is not very illuminating to discover that people do what they

intend to do' [37] even if in an organizational context such a study might not yield similar results since available working time is somewhat 'artificially' constrained by working hours and the rigorous financial calendar. The time required to execute the sum of intended behaviors on topics like strategy, reducing working capital, sales, customer relationship management and new business development may well outweigh the time available. This could be one of several reasons that the intention to manage IT does not translate into concrete behavior. Still, the intention to manage IT is expected to predict behavior since most organizations perceive an increasing relevance of IT due to both the significant cost and expected benefits, and will allocate time accordingly. Therefore, the first hypothesis is:

*H1: Intention to manage IT is positively associated with actual behavior for the three sub-processes project portfolio management, project management and life cycle management*

According to Ajzen, a person's intention to perform a behavior is influenced by three concepts. Firstly, their attitude towards this behavior, i.e. whether the person has a positive or negative attitude towards the behavior, secondly, the opinion relevant others have about the behavior, otherwise called the subjective norm (SN) and thirdly, perceived behavioral control (PBC) which is defined as the feeling a person has regarding their own ability to perform the behavior.

If IT is seen as 'valuable' then that positive attitude toward IT is expected to predict a positive intention to manage IT whilst this intention is not expected where IT is considered 'worthless'. The same is expected for the sub-processes.

Opinions of decision makers, colleagues and teachers are also expected to be predictors for the intention to managing IT which means that the perception of an organizational agent regarding the social pressure to work on IT–in other words the subjective norm on managing IT–is expected to set the agenda for that particular agent. Thus an agent's intention to manage IT will be determined by: decision makers declaring that PPM, PM and LCM are important, colleagues regularly discussing sub-processes and educational IT programs followed by the agent themselves.

The last predictor for intention is perceived behavioral control (PBC). PBC is, given the complexity of managing IT, a scarce capability. This capability is built from numerous abilities, such as, the ability to define requirements, build a business case on an IT investment, design a sustainable data model, create a database, customize an enterprise resource planning system, manage and control progress on an IT project, set up a web server, restore backups, program an interface etc. These capabilities require extensive education and/or training and organizational agents having invested time in mastering these capabilities are expected to have an intention to leverage them. This predictive power of PBC on intention is strengthened since an organizational agent who has mastered this capability will have the opportunity to utilize their "locus of value" [19] by increasing the budget or staff for which they are responsible, or by trying to access an increase in personal status like "a leather office chair" [54, 55].

We test the significance of the three TPB indicators on the intention for the sub-processes in hypothesis 2:

*H2: Attitude, subjective norm and perceived behavioral control are significant indicators of the intention to optimize the three sub-processes project portfolio management, project management and life cycle management*

Following the TPB theory, attitude, SN and PBC influence intention. The predictive power of attitude, SN and PBC are not expected to be equal or as Ajzen [36] describes it: 'The relative importance of attitude, SN, and PBC on the prediction of intention is expected to vary across behaviors and situations'. Ajzen [37] concludes that SN 'generally accounted for less variance than the other two predictors' and that 'for the behaviors considered, personal considerations tended to overshadow the influence of perceived social pressure. Melas et al. [56] studied and explained the relative low correlation found in other studies between attitude and behavior related to clinical information systems use. Other findings in corporate settings showed the strongest predictive power from both attitude [45] and subjective norm [57]. Armitage and Conner [58] state that in situations where attitudes are strong or normative influences are powerful, PBC may be less predictive.

A different split of the predictive power is expected in this study because of the current immaturity of managing IT–an immaturity which is widely publicized due to the propensity of popular press to cover failed IT initiatives (e.g. [59, 60]). Additionally, each of the sub-processes holds well-known challenges; a delayed time-to-market, too many projects running simultaneously and a modest return of the IT investment portfolio are all examples directly linked to suboptimal PPM [61–63]. Delivering projects on time and budget is still a major challenge within PM and in LCM challenges on data leakage, lost data due to back up problems, performance issues and downtime are present in a lot of organizations [64]. These issues are well known and many of them might prevent agents from translating a possible attitude or SN into intention. Conversely an increased PBC is usually the result of heavy personal investment by the agent in mastering IT through years of work and study. After such a high personal investment the probability of IT failure is reduced and it is expected that PBC predicts intention more strongly than attitude or subjective norm, which leads us to hypothesis 3:

*H3: Perceived behavioral control is the strongest indicator of intention to optimize the three sub-processes project portfolio management, project management and life cycle management*

## 3 Method

The research was performed via a structured online questionnaire comprising 72 questions. The constructs used a five-point Likert Scale and described five TPB variables for each of the three sub-processes and in total covered 15 constructs. IT knowledge was used as a gauge to select agents for the survey. After much consideration, it was decided to survey controllers as opposed to other roles such as information managers, IT experts, IT managers, information system users, CEOs and CFOs, as controllers cover all processes and outputs in the organization [65]. Controllers

support management by creating transparency on the consequences of decision-making and resource allocation. They also ensure the reliability and efficiency of the financial reporting and were, given the impact of IT on almost all processes in an organization, expected to be familiar with all three sub-processes. Finally, controllers may hold a more objective view, as they are not, unlike IT managers, reflecting the output of their own work which might otherwise produce a conflict of interest. The controllers were contacted through the "Stichting Instituut voor Control en Management Accounting Nederland", a non-profit-organization founded in 1994, which aims to improve the quality of the registered controllers and accountants. In total 6.052 registered auditors or controllers in the Netherlands were contacted and 213 respondents answered the questionnaire (3.5%). The respondents worked in both commercial and non-commercial organizations and in all kinds of industries–for example trade, public services and services–but mainly in financial services and production.

The concept PPM was explained within the questionnaire as '*management activities assuring that only the best IT-projects are started'* and even though more rigorous definitions of PPM aspire to an 'efficient portfolio' this definition [22] was not expected to be known by all interviewees. Instead, 'best projects' were defined in the questionnaire as those which generated more expected value with the same risk or the same expected value with less risk.

The concept 'project management' addresses both 'plan accuracy' and 'efficiency'. Where 'plan accuracy' is very well known in the financial community, within the questionnaire, the concept of 'efficiency' was reduced to '*delivering project output with as few resources as possible'*.

LCM is focused on 'technical efficiency' and whilst technical efficiency is a theoretical construct that is rarely used by controllers, it was translated operationally to '*getting the most out of the existing IT-assets'*. For each of these three sub-processes, questions around behavior, intention, attitude, SN and PBC were developed.

Since managing IT is a complex activity that consumes significant time, actual behavior was tested over the previous twelve months [9]. Behavior was measured using the verbs 'strengthened', 'helped' and 'advised' and subjectively addressed whether the respondent felt they had actually strengthened, helped or advised on the three sub-processes. Behavior was also loaded with a fourth measure on the improvement on the sub-process performance; this addressed the respondent's opinion on whether any actual improvement–such as '*better managing the IT-projects than during the prior 12 months*'–had occurred.

Intention was tested for a forthcoming period of three months. Given the continuous flow of project calls and the on-going activity of LCM it was felt that a period of three months covered enough opportunities to enhance the sub-processes. In medium and large enterprises, a significant proportion of the workforce was dedicated to IT and improving it was not solely up to a single individual. A controller needed the cooperation of their management. Their intention to advise and to help management as well as their 'overall' intention to improve the sub-process (comp. [66]) was the factors used to load the intention concept.

As noted, SN is the agent's perception of whether personally influential persons believe they should better manage IT and the questionnaire addressed three described dimensions; decision makers, colleagues and educational programs, which covered a

significant and relevant part of the participant's environment. SN of decision makers, colleagues and educational programs were not expected to correlate, since they can differ substantially; changes in the norm from decision makers for example, do not necessarily need to be reflected by educational programs. The causal relationship goes from the indicators into the latent construct. For that reason, they are, unlike the other concepts, not weighted with reflective but with formative measures [67, 68]. This is consistent e.g. with [66] who defined mimetic, coercive and normative pressure as constructs with formative measures.

The questionnaire was pre-tested by five persons with a similar background as the sample group and was optimized based on their feedback

## 4 Results

Most respondents worked for organizations with large revenues and high IT-budgets; more than 68% reported annual revenues over 50 Mio euros and 37% of the respondents reported IT budgets of over 10 Mio euros. For 28% of the participants the annual IT-budget was less than 1 Mio euros.

The reliability of all constructs using reflective measures was tested with Cronbach's alpha and Dillon-Goldstein's Rho. The validity was tested with the Average Variance Extracted (AVE) and the discriminant validity as set by Fornell-Larcker [69]. Based on these tests, a few items were excluded in the subsequent analysis. Three questions on intention were dropped since they excluded, unlike the other intention questions, the terms 'project portfolio management, 'project management' or 'life cycle management'. Where the interviewees were familiar with topics such as 'I will determine the minimum amount of resources needed for the upcoming three large IT-projects' they did not map these to the project management sub-processes. Three more questions on behavior were also dropped because they differed from the remaining nine behavior questions which described the behavior of the organization and not the activities of the interviewee.

The results of the tests on the constructs are presented in Table 1. The constructs all pass the AVE validity threshold of 0.5 [26] and the tests on the discriminant validity show that the latent variables explain the variance of their own indicators better than the variance of other latent indicators (i.e. the Fornell-Larcker Criterion is passed). Not all constructs pass the Cronbach alpha threshold of 0.7 [70] but the composite reliability tests, measured with Dillon-Goldstein's Rho, show a strong internal consistency [70]. The reliability of the congeneric model suffices for the statistical tests used in this study.

The hypotheses in this research are tested with a Structural Equation Model applying the variance-based model Partial Least Squares (PLS) [69]. The precondition of PLS for the models in this research–a sample size of 30–was fulfilled. The SmartPLS software [71] as described in [72] supported the analysis and the significance of the relations was tested in a bootstrap with 5.000 samples.

The results of the analyses with SmartPLS are presented in Figs. 2, 3 and 4. Figure 2 presents the three predictors for intention as well as intention and behavior for the PPM sub-process. The attitude construct was weighted with three reflective

**Table 1.** Reliability and validity of the constructs

| Sub-process | Construct | AVE | Fornell Larker-Criterion | Cronbach alpha | Dillon-Goldstein's Rho |
|---|---|---|---|---|---|
| PPM | Intention | 0.787 | Passed | 0.865 | 0.917 |
| PM | Intention | 0.680 | Passed | 0.764 | 0.864 |
| LCM | Intention | 0.765 | Passed | 0.847 | 0.907 |
| PPM | Behavior | 0.685 | Passed | 0.764 | 0.865 |
| PM | Behavior | 0.630 | Passed | 0.689 | 0.832 |
| LCM | Behavior | 0.641 | Passed | 0.705 | 0.832 |
| PPM | Attitude | 0.587 | Passed | 0.647 | 0.808 |
| PM | Attitude | 0.516 | Passed | 0.550 | 0.752 |
| LCM | Attitude | 0.623 | Passed | 0.695 | 0.831 |
| PPM | Perceived behavioral control | 0.615 | Passed | 0.381 | 0.760 |
| PM | Perceived behavioral control | 0.601 | Passed | 0.336 | 0.751 |
| LCM | Perceived behavioral control | 0.594 | Passed | 0.347 | 0.739 |

measures: PPMAtt1, PPMAtt2 and PPMAtt3. The subjective norm construct was loaded with three measures (PPMSN1, PPMSN2 and PPMSN3) with a formative causal relationship from these measures into the construct. The line between the PPMAtt predictor and the intention construct (PPMInt) indicates the explaining power of attitude on intention (0,181); the $R^2$ is written in the PPMInt box (0.324). Figure 3 holds the same TPB components for the PM sub-process as does Fig. 4 for LCM.

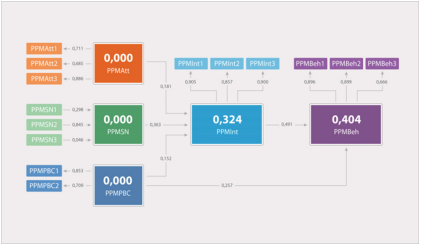


**Fig. 2.** Results on the model testing on Project Portfolio Management.

Based on the $R^2$ (0.322–0.336 for intention and 0.365–0.404 for behavior) we conclude that the effect sizes are 'large' [73] since effect sizes greater than 0.25 are rare in behavioral studies [74]. This analysis allows us to accept hypothesis 1, stating that intention is positively associated with behavior, for all three sub-processes. Attitude holds a positive influence on intention for PPM and LCM. This relationship is not statistically significant for PM. SN and PBC hold a statistically significant positive

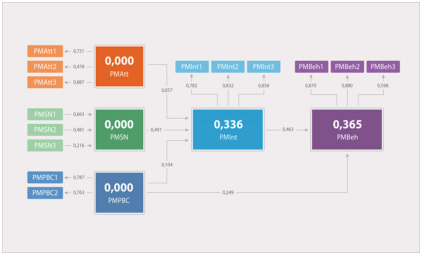


**Fig. 3.** Results on the model testing on Project Management.

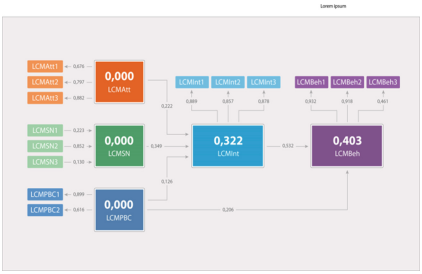


**Fig. 4.** Results on the model testing on Life Cycle Management.

influence on intention for all three sub-processes. SN clearly holds the strongest effect on intention (0.349–0.491); this is followed by smaller influences of attitude (0.181 for PPM and 0.222 for LCM) and an even smaller influence by PBC (0.104–0.152). Based on these insights it is clear that hypothesis 3 must be rejected for all sub-processes. SN is the strongest indicator on intention for IM. Table 2 presents an overview of the test results for all hypotheses.

The dominance of SN as a predictive power over PBC could indicate a mismatch in resource allocation and be used in future research to explain the high rate of IT failure. Future research could also consider drilling down to the SN concept by studying effects of not only the content but also the emotional expressions (comp. [75]) or on the most relevant SN influencers (e.g. the survey on most relevant users on Twitter [76]) or by expanding the social network (e.g. as has been done in BI software [77]). It could also focus on other constructs which influence intention such as goal clarity, curiosity and enjoyment (comp. [78]).

The confirmation of TPB for the sub-processes provides practitioners with simple but powerful instruments since they could influence behavior via intention simply by improving controllers' attitude, SN and PBC. SN is not only the strongest lever, but it can also be implemented more easily than attitude and PBC since attitude is deeply intrinsic and PBC requires significant time and effort. Practitioners, both managers as well as staff, could increase SN by clearly communicating a strong (noncompulsory) opinion on IT (comp. [79]) perhaps even supported by inputs from scientists or other influential practitioners. The formative measures show that subjective norm is

**Table 2.** Summary on the hypotheses testing

| Hypotheses | Result[a] |
|---|---|
| H1.1 Intention is positively associated with behavior for project portfolio management | Accepted (***) |
| H1.2 Intention is positively associated with behavior for project management | Accepted (***) |
| H1.3 Intention is positively associated with behavior for life cycle management | Accepted (***) |
| H2.1 Attitude towards PPM has a positive influence on the intention to use PPM | Accepted (***) |
| H2.2 Subjective norm PPM has a positive influence on the intention to use PPM | Accepted (***) |
| H2.3 Perceived behavioral control with respect to PPM has a positive influence on the intention to use PPM | Accepted (***) |
| H2.4 Attitude towards PM has a positive influence on the intention to use PM | Rejected |
| H2.5 Subjective norm PM has a positive influence on the intention to use PM | Accepted (***) |
| H2.6 Perceived behavioral control with respect to PM has a positive influence on the intention to use PM | Marginally accepted (*) |
| H2.7 Attitude towards LCM has a positive influence on the intention to use LCM | Accepted (***) |
| H2.8 Subjective norm LCM has a positive influence on the intention to use LCM | Accepted (***) |
| H2.9 Perceived behavioral control with respect to LCM has a positive influence on the intention to use LCM | Accepted (**) |
| H3.1 Perceived behavioral Control is the strongest indicator of intention to optimize project portfolio management | Rejected |
| H3.2 Perceived behavioral Control is the strongest indicator of intention to optimize project management | Rejected |
| H3.3 Perceived behavioral Control is the strongest indicator of intention to optimize life cycle management | Rejected |

[a](significance * $\leq$ 0.1, ** $\leq$ 0.05 and *** $\leq$ 0.01

especially strong amongst colleagues, followed by decision makers and educational programs. In other words, colleagues talking about and expressing the importance of IT will drive the intention of controllers to work on IT management.

Practitioners can also apply the finding that IT intention is a good predictor for IT behavior. Increasing the intention, e.g. just by asking 'do you intend to improve the bottom line impact of an IT euro?', is likely to lead to a higher intention where the answer is affirmative and thus encourage IT behavior (comp. [80, 81]). The findings of this study show that IT behavior depends largely on saying, and having your colleagues say, the right 'trigger' words.

## 5 Limitations and Conclusions

The study and results are limited for the Netherlands and the conclusions can only be generalized for other countries in case cultural, economic and other differences are taken in consideration. A second limitation comes from the focus on controllers. Controllers could be biased as compared to shareholders, IT-management or general management. Nevertheless, controllers are seen as the agents with the best in-depth knowledge on the value created by the sub-processes.

We conclude that the theory of planned behavior was confirmed for the three sub-processes of managing IT studied in this paper: project portfolio management (PPM), project management (PM) and life cycle management (LCM). The theory was tested to explain the behavior of agents in an organizational context and proved to be solid.

The confirmation of H1 as well as of H2.1, 2.2, 2.3, 2.5, 2.6, 2.7, 2.8, 2.9 shows that the theory of planned behavior can help explain drivers of intention and behavior for all three sub-processes. Intention drives behavior and is in turn influenced by attitude, subjective norm (SN) and perceived behavioral control (PBC) for the sub-processes PPM and LCM and by SN and PBC for PM. This indicates, following the TPB, that in case one of these increases, the intention could also rise.

We expected PBC to hold the strongest influence on intention. This was based on the widespread knowledge on the high risks of managing IT which would discourage untrained agents to engage in managing IT and conversely push trained agents who had invested significantly in their knowledge to leverage their IT-investment. But H3 was rejected and the data showed that intention was best predicted for Dutch controllers by SN. Furthermore, the results show that agents with a relatively low PBC nevertheless hold a relatively high intention to practice IT. On the other hand, agents with a higher PBC hold a lower intention to manage IT.

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