Relationship between Information Systems and Information Overload. A Preliminary Analysis

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ABSTRACT

The aim of this research is to investigate the role of information system in supporting companies to face with information overload. Specifically, the study provides an empirical analysis aimed to examine whether the quality of information systems is able to abate the negative effects of information overload/underload inside a company. Through a survey we assess the managerial feelings about the information overload (and underload) and the managerial assessment of the Information System (IS) quality. Preliminary empirical findings of our survey confirm, by performing a factor analysis, previous literature and suggest the items to be monitored for assessing the information underload and information overload phenomena and the dimensions to take into account for evaluating the IS quality, namely, information processing capacity, technical equipment and communication. Furthermore, results show that when the information underload increases, the information processing capacity of IS decreases and vice versa. This relation suggests that the IS quality could affect the information overload/underload phenomena.

Indexing terms/Keywords

Information Overload, Information Systems, Information Technology, Decision-making process

TYPE [METHOD/APPROACH]

Survey, Descriptive statistics, Factor Analysis

INTRODUCTION

In today's society, companies are facing with day-to-day activities that increasingly involve their information load. Managers could be not able to manage effectively their decision-making process, as the information available are too much, or irrelevant, or they suffer the time pressure to provide an answer to a question of a solution to a problem [1]. In similar situations, managers are not able to prioritize their tasks and thus the decision-making process collapses.

The decision accuracy in conditions of information overload decreases and also the managerial productivity diminishes. This phenomenon is also due to the frequency and the amount information such as email, tweets and other social network updates related to the work environment [2].

Information overload is thus a phenomenon that refers both to the technical component of Information Technology (IT), and to the individuals. Even in the '70s and '80s, when the Internet was not yet available to everyone like in current days, managers preferred to feel more confident in solving problems or taking decisions seeking more information than they needed. This phenomenon found certainly favourable conditions in the emergence of the Internet [3]. Therefore, humans and technologies are both causes and solutions to the problem.

According to prior studies the Information Overload phenomenon is due to the decision-maker approach, that may lead him/her to select a bigger amount of information than that required for the specific task to be accomplished, or the problem to be solved [4–6]. More recent studies, confirm that such an over-collection of information is made faster and easier by the Internet and the IT tools, thus one of the causes of the information overload is the Information Technology, along with human-related and process-related factors [7]. The controversial fact that IT could be both a cause and a solution to Information Overload is thus demonstrated by the literature. However, literature also shows that the quality of Information System (IS) may affect the decision-making process [8], especially considering the significant support provided by the DSS (Decision Support Systems) [9–11]. Therefore, we could hypothesize that the more the decision maker is equipped with advanced IT tools, the less he/she feels the need to oversearch for information; consequently, we could hypothesize that the higher the quality of the IS, the fewer the frequency of perceiving Information Overload.

Thus, in this research, we perform a survey aimed at investigating whether the quality of Information Systems (IS) is associated with the occurrence of information overload (and underload). Hence, for this research, we analyze the literature regarding information overload and underload and the literature referring to the IS quality models.

Our contribution to the literature is to provide an analysis which, more closely than other scholars, put in comparison the information overload with the IS, wondering whether the quality of IS could explain (or could be a solution for) the information overload.

Next section of the paper shows the literature analysis in the field of information overload and in that of the IS quality; the third section deals with the methodology used; the fourth discusses the findings obtained and the fifth shows the conclusions, limitations and suggestions for future researches.

LITERATURE REVIEW

Information Overload

The phenomenon of information overload (and underload) has born as a consequence of information age, in 1970s, with the widespread use of organizational computing systems [12].

First studies on information overload/underload are conducted in the '70s. Ackoff (1967) describes the weaknesses of Management Information Systems as being designed assuming that the deficiency under which manager operate is the lack of relevant information [13]. Other main studies on information overload are conducted in the '80s by O'Reilly (1980), who realized that the information overload happens every time that the quantity of information surpasses an individual's information processing resources [14]. Galbraith (1977), Tushman and Nadler (1978) lay down the theoretical bases of information overload, asserting that companies facing uncertainty need to adjust their information processing capacities to adapt successfully to the different environments, but, when the information processing capacity is not aligned anymore to the information processing requirements, then companies enter in a condition of information overload [15,16]. Several empirical researches support these theoretical views [14,17,18].

First literature suggestions for preventing information overload consist of: a) avoiding to assume that more information is always needed by managers [13]; b) do not provide more information to managers but make a better use of information already available [13,19]; c) while a bigger amount of relevant information leads to better decision making process [20,21], a bigger amount of irrelevant information reduces the manager's capacity to recognize the relevant problem and to carry out an effective decision-making process [22,23]. When a manager receives [many] irrelevant information, instead of [a few of] relevant information, he/she is not able to accomplish his/her job. Therefore, a situation of information underload happens when managers receive less than the amount of information they would need for accomplishing their decision-making process [14], and when they receive irrelevant instead of relevant information.

Several studies show that managers tend to induce information overload by seeking more information than they need and, at the same time, by not using the information that they already possess [4,5]. This behaviour could depend on two main reasons: first, more available information reduces perception of uncertainties and increase manager's feeling to have a better control of the situation [6]; second, managers feel more confident and satisfied if they collect more information, even when they cause overload [24]. The paradox, as explained by O'Reilly (1980), is that while managers lose decision accuracy as a consequence of the information overload, at the same time they feel more confident and secure [14]. Alas, beyond a certain level of information load, further information does not provide any improvement to decision accuracy, on the contrary, the performance tends to decrease as shown in Figure 1 [25].
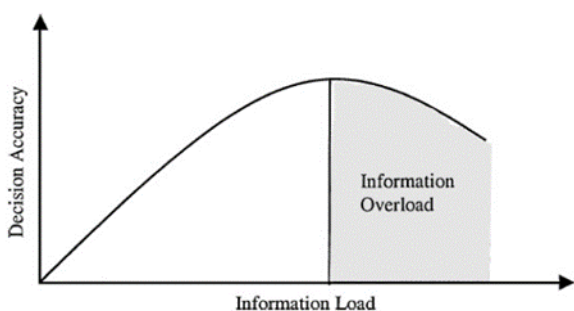

Figure 1: Information overload as the inverted U-curve (Source: Eppler and Mengis, 2004)

Information overload normally refers to the concept of receiving too much information [7] and involves several disciplines, such as accounting [26], management information system [27], organization science [16] and marketing [28], and the common objective of each of them is to investigate how the performance of an individual varies in accordance with the amount of information available [7].

However, information overload is not related only to the amassing of information, in fact, managers could feel information overloaded because of the time pressure to accomplish their tasks and the inability to prioritize tasks optimally [1]. Moreover, communication is another relevant aspect which influences the information overload. In fact, as shown by Meglio and Kleiner (1990), in many cases information users contribute to information overload as their communication is not effective enough [29]. Factors influencing information overload could be individual (knowledge base, decision style) and task-related (amount of information processes, task complexity, number of information exchange interactions) [1]. In this regard, some studies show that managers tend to invest in technology, to meet the workers' needs and increase their productivity, but they do not realize that technology itself could give raise to technology overload, which is a combination of information overload, communication overload and system feature overload [30]. Investing in technology beyond a certain level does not increase the productivity, on the contrary, it can lead to a loss of productivity.

In relation to the factors influencing the information overload, some studies focus the attention on the decision style. For example, Bettis-Outland (2012) asserts that incremental decision making produces less information overload than comprehensive decision making, as the first considers less alternatives in solving a problem, while the second, due to its nature, leads managers to find all the possible alternative solutions [12]. However, it is very difficult for companies operating in uncertain conditions to benefit of the advantages of incremental decision making.

Speier et al. (1999) focus the attention on another factor of information overload, the task performed, and show that tasks characterized by frequent interruptions are more likely to produce information overload [31]. Hiltz and Turoff (1985) and Miller (1994) deal with the amount of information as a cause of information overload [32,33], while Eppler and Mengis (2004) and Tushman and Nadler (1978) deal with the information processing requirement needed to manage the information load [7,16] and Stvilia et al. (2005) address the issue of information quality, which can affect the manager's information processing capacity [34].

Literature widely agree on the fact that managers, in order to feel more confident in solving problems or taking decisions, sought more information than they needed. This phenomenon found favourable conditions in the emergence of the Internet [3]. Nowadays, in fact, to acquire, communicate and store huge amount of information is much easier and faster than in the past; hence, on one side, IT can help managers by supporting their decisions, but on the other side, it could be used improperly (overused or misused), in doing so increasing the information overload. Moreover, it seems partially correct to attribute to the sole technology the role of solving information overload problems, as literature shows that information overload is also affected by many other information system-related variables.

Information Overload and Management Information System

Considering which are the main factors that the literature recognizes as affecting [or provoking] information overload, it seems quite clear that the capacity of the companies to efficiently manage data and information, depends largely on the quality of Information Systems [35–38]. Literature shows that very often managers experience the paradoxical situation consisting in having an abundance of information available, but to find high difficulty in selecting the relevant information when it is needed [39]. An IS is a symbiotic relationship between system users and the system itself [40,41], in fact, it is defined as "a set of elements interconnected which collect (or recover), process, store and disseminate information in order to support decision and process control in organisation" [42].

Basing on the literature, it seems that information overload could be reduced or faced through an effective information system and thus, through an optimal use of Information Technology (IT), both on the technical and on the human perspective. Any performance analysis conducted on the information system have to take into account both the costs of the IT itself and the needs of the users [40].

The main aim of IT systems is to support decisions and "to provide the right information, in the right time at the right person" [43]. Scholars have highlighted that IT could support the introduction and the diffusion of a Management Information System (MIS) which represents a huge investment and involves the entire organization [44]. IT is able to collect and integrate data using a common database, and thus it represents a good basis for the overall accounting process [45]. Its usage is generally justified by the need to share consistent information across different functional areas of a company [46].

Several authors highlight the effects that IT systems could produce on the final users, uncovering the positive and general impacts that IT adoption may have on the reliability, timeliness, comparability and relevance of accounting information for external and internal users [47–49]. Furthermore, a quite recent stream of literature about IT has investigated some potential benefits that IT could have on management control systems, such as better planning and management of resources, a reduction in the time needed to perform managerial activities, an improvement in the quality of data and control activities in general [50,51].

On an opposite stand point, Brazel and Dang (2008) found that some kind of IT investments (such as the implementation of Enterprise Resource Planning systems) would allow manager to use more discretion over accounting information and to favor data manipulation [52]. Further studies on the negative effects of the IT use are focused on IT usage-related stress, work overload [53,54] and interruption [55]. These negative effects are determined by some features of the IT system, such as complexity and uncertainty and by the environment in which the IT is implemented [56]. In particular, the complexity and uncertainty seem to be aggravated by networked enterprises [57] and by Engineer-to-Order business [58,59].

However, given the presence of costs and benefits that IT could bring about, literature provides numerous studies to understand how the quality of IS/IT could be obtained and measured.

The analysis of the IS/IT quality is carried out by several scholars, under different perspectives and using different methods: Nelson et al. (2005) develop a model based on nine determinants of quality in an IT environment, four focused on the output of the system (i.e. the information quality) and five addressed to the information processing system needed to produce the output (i.e. the system quality) [60]. The determinants of the information quality are the accuracy, the completeness, the currency and the format. The determinants of the information processing system quality are the accessibility of the system, its reliability, the response time, the flexibility and the integration. Nelson et al. (2005) find out that such nine determinants are predictive of general information and system quality in data warehouse contexts.

Similarly, other scholars identify the critical success factors of a high-quality IS. For example, De Lone and McLean (1992), as a result of a review of the main IS literature on IS quality, summarize in six factors the aspects that literature

analyzes: a) system quality, intended as the information processing system itself; b) information quality, that is accuracy, timeliness, reliability, completeness, relevance, precision and currency; c) information use; d) user satisfaction; e) individual impact; f) organizational impact [61]. After about twenty years, De Lone and McLean update their study, proposing other determinants that can affect the IS success, classified in four categories: task, user, project, organization [37].

Some studies break down specific IS quality aspects, such as the IS service quality, strictly related to the user dimension. The idea of the service quality is that users [the employees of the company] are satisfied only if their expectations, using the software, fit their perception of the quality that they are getting [62].

As literature shows, there is not a single determinant which can, on its own, explain the quality or the success of the IS, but it is necessary to include variables pertaining to the following aspects: technique, communication, user satisfaction. Thus, the quality of IS seems to be important for managing (or facing) information overload and, because Information Technology (IT) is even more integrated into the IS, it could play a significant role in assessing the IS quality.

On this bases, we define our research question:

"*Does the quality of Information System affect the information overload / underload?*"

In our opinion, the match of the literature on information overload with that related to IS quality, provides elements that justify our intent to investigate whether the quality of Information System affect, positively or negatively, the information overload phenomenon. Hence, in order to face, reduce or prevent information overload, IS should be:

- equipped with technical elements (software) well integrated between them;

- composed of a reporting system able to make communication effective;

- supported by users which are satisfied of the IT tools they use and well informed about the company's decisions.

METHODOLOGY

Sample Selection, Data Collection and Survey

In order to answer the research question, we conduct a survey on a sample of 100 Italian managers who work for Italian listed or non-listed companies of different size . The participants – Chief Information Officers, Chief Technology Officers, Chief Executive Officers and Controllers – are randomly selected from the LinkedIn social network database, as some scholars have recently stressed the relevance and widespread use of this social media applications [64]. Furthermore, the growing interest in LinkedIn by practitioners has also been documented by the Association of Accounting Marketing [65]. The main aim of the survey is to test the research design and to elicit preliminary evidence from our study [66]. The survey was split into 6 sections as follows: 1) personal data of the interviewee; 2) features of the firm; 3) the quality of accounting information system; 4) communication and reporting; 5) information overload and underload; and 6) overall judgement on IS and suggestions.

As the empirical analysis is based on a survey, most of the research variables measure the managers' perception, which could be interpreted as management satisfaction with the survey issues [63]. We received back 32 answers (32% rate of response).

Measurement of the Research and Control Variables

Surveys allow us to define the research and control variables. The quality of IS is measured by taking into consideration the main items emerging from the literature [37, 61, 62] which regard the three following areas: technical equipment, information processing capacity and communication.

With regard to the first, we detect 1) ERP adoption (the survey question is "Does your firm adopt an ERP system?" *1 = Yes; 0 = No)*; 2) legacy system adoption (the survey question is "If the firm does not adopt an ERP system, does the firm adopt a legacy system? *1 = Yes; 0 = No*); 3) the frequency of upgrade (the survey question is "How often does your firm update the ERP or alternative IT system in the last three years? *1 very rarely,….,7 very often*).

With reference to the second area (information processing capacity), we use the following items: 1) data accuracy (the survey question is "What is your perception of the accuracy of data to perform your tasks?" *1 very low,…, 7 very high*); 2) timeliness of data; (the survey question is "What is your perception on the timeliness of data to perform your tasks?" *1 very low,…, 7 very high*); and 3) system reliability (the survey question is "What is your perception on the capacity of information system to address the right choice to the right person in the right moment?" *1 very low,…, 7 very high*).

Relating to the third area (communication), the items are: 1) the reporting frequency in a month (the survey question is "Which is, on average, the number of report issued in one month? *1 very low,…, 7 very high*); 2) the reporting frequency within six months (the survey question is "Which is, on average, the number of reports issued in a six-months period? *1 very low,…, 7 very high*); 3) the annual reporting frequency (the survey question is "Which is, on average, the number of report issued annually?, *1 very low,…, 7 very high*); 4) the frequency of flash-reporting (the survey question is "How often are flash reports issued? *1 very low,…, 7 very high).* The perception of information overload and underload is measured according to prior literature (O'Reilly 1980; Karr-Wisniewski and Lu 2010). In particular, the information underload is measured through the following items: 1) less information (the survey question is "How often do you realize to have less

than the amount of information you would need to make the best possible decision? *1 very rarely,..., 7 very often)*; 2) less IT resources (the survey question is "How often do you realize to have less than the amount of IT resources you would need to make the best possible decision? *1 very rarely,..., 7 very often*); 3) no information (the survey question is "How often do you feel you are not receiving all the information you need? *1 very rarely,..., 7 very often)*. The information overload is measured through the following items: 1) surplus of information (the survey question is "How often do you realize to have more than the amount of information you would need?" *1 very rarely,..., 7 very often*); 2) too many IT resources (the survey question is "How often do you realize to have too many alternative technologies to use for the same problem?" *1 very rarely,..., 7 very often*); 3) too much information (the survey question is "How often do you realize you are receiving too much information respect to the amount you would need? *1 very rarely,..., 7 very often*).

Control variables either respondents' features or firms' features. About the first, the points are the following: 1) the role of respondents and 2) the gender of the respondents; about the firms features, the control variables are: 1) the size of the firm, 2) the sector of the firm and 3) the type of the firm.

Descriptive Statistics of the Research and Control Variables

Even if the analysis is preliminary, tables 1, 2, 3, 4 and 5 show some descriptive statistics of the items encompassed in the research variables, whereas table 6 shows some descriptive statistics of the control variables.

Table 1. Descriptive statistics of items encompassed in the technical equipment (Number of observations: 32)

Research variables	Minimum	Maximum	Mean	Standard Deviation
ERP adoption	0	1	0.750	0.440
Legacy system	0	1	0.250	0.442
Frequency of upgrade	1	7	3.500	2.272

Table 2. Descriptive statistics of items encompassed in the information processing capacity (Number of observations: 32)

Research variables	Minimum	Maximum	Mean	Standard Deviation
Data accuracy	1	7	4.310	1.712
Timeliness of data	1	7	3.880	1.699
System reliability	1	7	4.190	1.693

Table 3. Descriptive statistics of items encompassed in the communication dimension (Number of observations: 32)

Research variables	Minimum	Maximum	Mean	Standard Deviation
Reporting frequency monthly	1	7	4.380	1.879
Reporting frequency every six months	1	7	4.090	1.855
Annual reporting frequency	1	7	4.130	2.028
Flash-reporting frequency	1	7	4.660	1.894

Table 4. Descriptive statistics of items encompassed in the information underload (Number of observations: 32)

Research variables	Minimum	Maximum	Mean	Standard Deviation
Less information	1	7	4.090	1.838

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Less resources IT	1	7	4.160	1.986
No information	1	7	3.880	1.897

Table 5. Descriptive statistics of items encompassed in the information overload (Number of observations: 32)

Research variables	Minimum	Maximum	Mean	Standard Deviation
More information	1	4	2.250	1.047
More resources IT	1	7	2.340	1.537
Too much information	1	6	2.340	1.359

Table 6. Descriptive statistics of control variables (Number of observations: 32)

Research variables	Minimum	Maximum	Mean	Standard Deviation
Gender	0	1	0.060	0.246
Role	1	5	2.690	1.230
Type of firm	1	4	2.000	0.622
Firm size	1	4	2.470	0.950
Sector	1	3	1.690	0.535

Empirical Model and Findings

We standardize each research and control variable. Therefore, we perform a principal component analysis (Table 7) in order to build research variables defined with a 1-7 Likert scale [67]. To test the validity and reliability of the factor analysis we performed Keiser-Meyer-Olkin test to test the sampling adequacy [68], Bartlett's sphericity test [69] and assessed the scale reliability through the analysis of the Cronbach's alpha [70]. We also checked for the eigenvalue of each item in order to check how many factors should be retained into the analysis [71]. Factor analysis confirms the reliability of the research variables that are thus created through the sum of items encompassed in the research variable as shown in table 7. Table 8 shows some descriptive statistics of the research variables. Table 9 shows correlation matrix and Pearson index for the research variables.

Table 7. Factor analysis of the research variables.

Item	Factor loading	Communality	Eigen value	Cronbach's alpha	Bartlett's sphericity test	KMO*
Information processing capacity						
Data accuracy	0.911	0.830	2.289		Chi2=39.542	
Timeliness of data	0.889	0.790	0.473	0.844	p-Value= 0.000***	0.693
System reliability	0.818	0.669	0.238			
Communication						
Reporting frequency monthly	0.840	0.705	2.720	0.659		
Reporting frequency every six months	0.930	0.865	0.710			

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Annual reporting frequency	0.794	0.630	0.434			
					Chi2= 62.682	0.840
Flash-reporting frequency	0.721	0.520	0.136		p-value =0.000***	
Information underload						
Less information	0.933	0.871	2.563		Chi2= 64.006	
Less IT resources	0.898	0.806	0.284	0.742	p-value =0.000***	
No information	0.941	0.886	0.153			0.915
Information overload						
More information	0.790	0.624	1.870		Chi2= 15.338	
More IT resources	0.818	0.669	0.620	0.665	p-value =0.002***	0.697
Too much information	0.760	0.577	0.509			

Table 8. Descriptive statistics of the research variables (Number of observations: 32)

Research variables	Minimum	Maximum	Mean	Standard Deviation
Information processing capacity	3.000	21.000	12.375	4.456
Communication	4.000	28.000	17.250	6.284
Information underload	3.000	21.000	12.125	5.284
Information overload	3.000	12.000	6.937	3.121

Table 9. Correlation matrix and Pearson index (Number of observations: 32)[1]

	IU	IO	IPC	C	ERP	LS	FU
Information underload (IU)	1						
Information overload (IO)	0.038 0.838	1					
Information Processing Capacity (IPC)	- 0.609 ** 0.000	0.060 0.745	1				
Communication (C)	-0.079 0.669	0.180 0.324	0.380 * 0.032	1			
ERP adoption (ERP)	0.014 0.940	- 0.106	0.263 0.145	0.245 0.176	1		

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[1] First entry of each cell shows the Pearson index, the last entry shows the Sign (two-tailed).

		0.565					
Legacy system (LS)	-0.023	0.172	- 0.225	- 0.275	- 0.816**	1	
	0.916	0.421	0.291	0.193	0.000		
Frequency of Upgrade (FU)	-0.102	0.259	0.204	0.104	0.032	-0.053	1
	0.578	0.152	0.263	0.571	0.861	0.808	

* Correlation is significant at 0.05 (2-tails). ** Correlation is significant at 0.01 (2-tails).

Correlation matrix highlights a negative correlation between information underload and information processing capacity that is a dimension of the IS quality. This means that if the information underload increases, the quality of IS measured through the information processing capacity decreases and vice versa. Correlation matrix also shows a positive correlation between information processing capacity and communication and a negative correlation between ERP adoption and legacy system.

CONCLUSIONS, LIMITATIONS AND FUTURE RESEARCHES

Information overload (and underload) could represent a serious limit for a company, as it can compromise the effectiveness of the decision-making process. Literature shows quite clearly that information overload reduces decision accuracy [7] and, consequently, the performance of managers. This phenomenon happens whenever the quantity of information that the individual receives, surpasses her/his capacity to process it [14] and thus, it happens more frequently in companies which face the uncertainty of their sector. These companies, to face with the information overload, should adapt their information processing capacity to the changing conditions of the environment [14,17,18].

Moreover, this phenomenon occurs when managers receive amount of information that are not relevant for the tasks they have to achieve. Furthermore, information overload is not only related to the amount of information to manage, but also to the time pressure that managers feel in performing their job and to their incapacity to prioritize tasks optimally [1]. With the emergence of the Internet, we assist to two contrasting behaviours: on one side, companies invest in powerful IT tools in order to look for data, to elaborate data, extract information, to make data mining on websites, email and documents, in doing so producing a plenty of data and information to store, to manage and to communicate; on the other side, companies invest in IT to deal with the information overload due to the huge amount of data that they receive incessantly.

Preliminary empirical findings of our survey, obtained through a factor analysis, confirm previous literature and suggest the items to be monitored for assessing the information underload and information overload phenomena and the dimensions to take into account for evaluating the IS quality, namely, information processing capacity, technical equipment and communication. Furthermore, results show that when the information underload increases, the information processing capacity of IS decreases and vice versa. This relation suggests that the IS quality could affect the information overload/underload phenomena [and vice versa], partially answering our research question "*Does the quality of Information System affect the information overload / underload?"* However, empirical evidence also shows that there is not an association between each component of IS quality and information overload/underload, but the association is found only for one of the IS quality items.

This research provides a preliminary investigation of the information overload/underload, a phenomenon which is still felt by managers, as demonstrated by the results of the survey, even in these days characterized by such a consistent use of IT.

Nevertheless, in our study, the sample of managers is not selected according to the industry and this could be a limitation, considering that companies belonging to industries characterized by higher uncertainty are more likely to face information overload, respect to companies belonging to industries with a more stable environment. Another limitation is due to the small number of observations. To measure the IS quality is a complex task because the IS itself is multifaceted and its quality could depend on several determinants [37], therefore, the increase in the number of observations would lead to a higher significance of the results. As future research, in addition to extending the number of observations, it would be useful to submit the survey to companies in two different moments: before and after an IS/IT investment, by doing so comparing the managerial perception of information overload/underload before and after the purchasing of the new technology. This would allow a better perception of the effects of the investment on the information overload.

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