AUTOMATION AND SUBSTITUTION OF HUMAN KNOWLEDGE: ASSESSMENT WITHIN THE INFORMATION SYSTEM CONTEXT

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Abstract

Industrial psychology sets forth that human knowledge has an impact on performance. Literature on information systems proposes that usefulness of an information system also contributes to performance results. An economic approximation suggests that people and technology are substitutable factors to produce outputs. This study focuses on analysing the substitution effect between people (based on their knowledge) and technology (based on its usefulness) in different automation levels.

We gathered data from 125 users. The results show that the higher the level of automation the lower the effect of knowledge on performance and higher the impact of usefulness on performance. The design of information systems can use this moderating effect to assign tasks (between individual and technology) based on convenience and timeliness, but the negative factors of a higher level of automation should be taken into consideration, such as impairment of the employee's knowledge.

Keywords: Technology, knowledge, performance, usefulness and automation.

1. INTRODUCTION

Traditionally, industrial psychology proposes that human knowledge and effort are factors that determine performance (McCloy, Campbell, & Cudeck 1994). Presently, technology has started to have a more significant role in most tasks (Elias, Smith, & Barney 2012) and in several organizations, performance is closely related to the use technology (Sonnentag & Frese 2005). On the other hand, literature on information systems propose that the usefulness of an information system contributes to performance (Seddon 1997). Individual factors (e.g. knowledge) and technology (e.g. usefulness) apparently have a significant role in performance (Bravo, Santana, & Rodón 2015).

Moreover, the task allocation literature suggests that organizations are expected to design the work of individuals by assigning a specific level of participation to technology for performing tasks (Price 1985). However the level of intervention is not discrete (all or nothing) but instead a continuum that goes from fully carried out by a human without the aid of technology to fully performed by technology without human aid (Frohm, Lindström, Stahre, & Winroth 2008).

In this context, a question arises whether, the higher the level of automation, the impact of usefulness and knowledge on performance varies. The answer to this question is also relevant to management, to the extent that the performance evaluation of an individual would be contingent on the design of the task.

Literature regarding economy suggests that in a production process, there are complementary and substitutable factors. Two factors are complementary if together they can improve one another in the production of results (in our case performance); and two factors are substitutable if they can be replaceable each other and maintain the same production level (Hitt & Snir 1999).

Literature recognizes the dual function of technology, whether it complements or substitutes the individual in the production process. Even though there is a theoretical and empirical research based on the complementary or substitutable nature of these production factors, such research has been developed at an organizational or industry level (Lin & Shao 2006); however, there sparse attention has been given to the research made at an individual level. In this sense, this study is focused on the substitution effect of factors at an individual level.

In general terms, literature states that technology substitutes individuals because computers can carry out certain tasks automatically. Orlikowski and Iacono (2001 p. 123) state that the notion that technology replaces an individual can be traced back to the beginning of automation. Parasuraman, Sheridan, and Wickens (2000 p. 286) define automation as a measure in which technology is carried out (fully or partially) for activities that used to be carried out by humans.

Specifically, literature recognizes that technology replaces individual's knowledge. Zuboff (1985 p. 8) establishes that technology has the privileged ability to replace human skills when automation occurs. Braverman (1998 p. 319) considers that the higher the level of science (i.e. knowledge) included in technology; the individual will have a lower level of science. Recently, Axelsen (2012) explored the introduction and continuous use of computer assistance so that auditors can take decisions and found that this assistance resulted in the impairment of the individuals' knowledge.

However, based on the review of literature, there is no study that empirically analyzes the substitution effect at an individual level in the context of information systems.

Therefore, this study focuses on whether, simultaneously, the level of intervention moderates negatively the relationship between knowledge and performance and positively the relationship between usefulness and performance.

This article is broken down as follows: first, hypotheses are developed; then, an empirical assessment is carried out and finally, conclusions are presented.

2. RESEARCH FRAMEWORK WITH HYPOTHESES

2.1 Knowledge of the Task and Performance

Literature has acknowledged that the knowledge of individuals has effects on performance. Industrial psychology distinguishes between declarative and procedural knowledge. Declarative knowledge is associated with knowing facts, principles or a particular discipline to carry out the tasks. Procedural knowledge is that which allows the transfer of that body of knowledge to the practical execution and relates to knowing how to carry out the tasks. For the purposes of this article, «knowledge of the task» is the degree of understanding of the requirements of the task (knowing what to do) and the processes to carry it out (know how) (Anderson 1989; Kanfer & Ackerman 1989; Quinn, Anderson, & Finkelstein 1996).
Conceptually, if an individual knows what to do and how to carry out the tasks, he will have a greater possibility of achieving his objectives and minimizing errors or delays, which will affect performance (Schmidt & Hunter 1998; Schmitt, Cortina, Ingerick, & Wiechmann 2003). Several empirical studies have established a positive relationship between knowledge of the task and performance (Borman, White, Pulakos, & Oppler 1991; Bravo et al. 2015; McCloy et al. 1994; Muhammed, Doll, & Deng 2009).

This is the basis for the following hypothesis:

H1: The knowledge of the task has a direct and positive influence on the individual performance.

2.2 Ease of the Task and Performance

Industrial psychology has recognized the complexity of the task (or its opposite in this article: ease) as one of the most significant determinants of performance (Gwizdka & Spence 2006; Liu & Li 2011). Subjective complexity, states that complexity lies in the perception of the executor, based on his experience of carrying out the task (Campbell 1988; Gill & Hicks 2006). In this article «ease of the task» is to be understood as the degree in which the task is perceived as easy to carry out (Gwizdka 2009; Mangos & Steele-Johnson 2001; Maynard & Hakel 1997).
Conceptually, complexity has a negative effect on performance. It is likely that a more complex task will exceed human processing capacities, and thus adversely affect performance (Campbell 1988; Liu & Li 2011; Yeo & Neal 2004). Several empirical studies have established a negative relationship between complexity of the task and performance (Maynard & Hakel 1997). This is the basis for the following hypothesis:

H2: The ease of the task has a positive impact on the individual performance

2.3 Usefulness and Performance

Usefulness is defined as the degree to which the individual assesses that the technology has improved his performance (Seddon 1997). An increase in performance implies greater efficiency or effectiveness of the individual (Goodhue & Thompson 1995).

Conceptually, a useful technology affects performance inasmuch as the information system facilitates the individual's work in achieving his purposes. Seddon (1997) holds that an information system is useful if it produces benefits, such as helping the user to do more or better work in the same time, or the same quality and quantity of work in less time. Alter (1999) suggests that the effect of the information system on performance is determined by the degree to which the technology carries out the roles of providing information and/or automating activities. Fulfilling these roles may be considered as the valuation of an individual on the usefulness of a given technology for the carrying out of the tasks. This is the basis for the following hypothesis:

H3: The usefulness of the information system has a positive impact on the individual performance

2.4 Automation Level and Moderate Effects

In literature regarding automation, Kaber and Draper (2004) illustrate the intervention of technology through two dimensions. On the one hand, the amount of tasks to be automated as compared to the total tasks in charge of a person. On the other hand, for each automated task, the automation level applicable (or subtasks or activities that will be placed on the system). In this framework, several authors reflect different technology intervention levels through these two dimensions. Parasuraman et al. (2000) propose four tasks: acquiring data, analyzing data, making a choice and implementing it. And for each one of these tasks, the level of technology intervention can be higher or lower. Additionally, Endsley and Kaber (1999) propose ten levels of technology intervention based on a combined assignment of the human or technology in four tasks (monitoring, generating alternatives, selecting alternatives and implementing decisions). The more tasks assigned to technology, the higher the level of intervention. This suggests that the level of intervention is not discrete (either everything or nothing), it is continuous and it goes from fully executed by a human without technology intervention, to fully executed by technology without human intervention (Frohm et al. 2008; Parasuraman et al. 2000).

Within this framework, the “level of system intervention” is defined as the level in which technology is involved in performing an individual’s activities.

The central proposal of this article states that provided that the intervention level increases, technology (represented by its usefulness) is more relevant than the individual (represented by their knowledge) to reach similar performance levels (See Figure 1).

In economy, two factors are substitutes if one can be exchanged for another to maintain the same level of production. The production function corresponding to a substitution effect is: $Z = a + bX + cY$ (elasticity factor = c / b). This equation assumes that technology (defined as production system) is constant (i.e. a, b and c are constant for any value of X or Y). However, if the technology changes the function of production changes: $Z = a' + b'x + c'Y$ (and the new elasticity factor = b' / c') (Beattie & Taylor 1985). In our case, we can consider that: X = Knowledge of the task, Y = Usefulness and Technology = Level of intervention. To that extent, a more intensive computer processing technology could reduce the elasticity of the factors reducing the impact of knowledge and increasing the impact of the utility. This would set a moderating effect from the economic perspective.

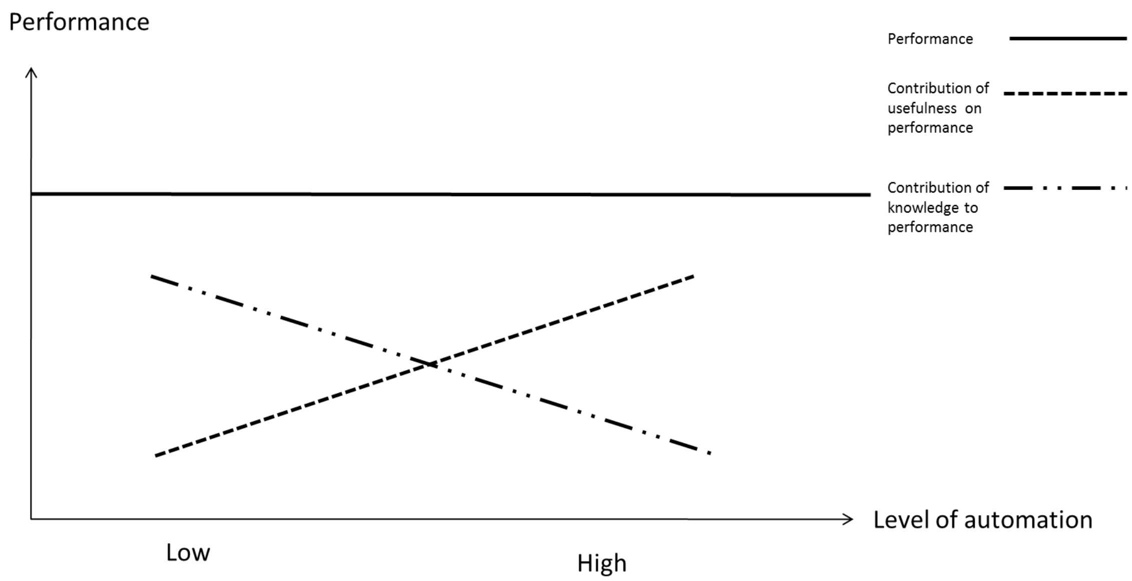

Figure 1. Replacement effect of system usefulness and individual knowledge

In IS context, the lower the level of intervention, more tasks are assigned to humans. In this regard, it is reasonable to expect that individual knowledge (declarative and procedural) will have a significant contribution (regarding technology usefulness) on performance. Therefore, if there is no technology, and considering other factors remain constant, performance can be determined by knowledge.

On the other hand, the higher the level of intervention, more tasks are assigned to technology. In this regard, it is plausible to expect that technology usefulness will have an outstanding contribution (as compared to human knowledge) on performance. Therefore, if tasks are fully automated without human intervention – and considering other factors remain constant – performance would be determined based on the usefulness of technology.

The effect of replacing human knowledge for technology to obtain similar performance levels has a two-pronged reason. First, the higher the level of intervention, more knowledge of the task is transferred from the individual to technology. Zuboff (1985 p. 7) argues that in the automation process, human skills are assumed by technology. Markus and Tanis (2000 p. 189) states that several business procedures are embedded in information systems and these procedures code several rules, standards, data and formulas (Soh, Kien Sia, Fong Boh, & Tang 2003 p. 85). Such rules, data and formulas comprise knowledge that used to be maintained in individuals and that now are embedded in technology. The higher the level of intervention, technology may own more information and knowledge to carry out the task efficiently.

Second, the higher the level of intervention, the more processing capacity is transferred from the human processor to the computer processor. Several authors suggest that computer processing can be superior to human processing. Fitts' list, referenced by Hoffman, Feltovich, Ford, and Woods (2002), states which activities the human being can be surpassed by technology (e.g. execution of repetitive tasks, managing complex operations, deductive reasoning) and where the human being surpasses technology (e.g. improvisational skills, application of professional judgment and reasoning). Mukhopadhyay, Lerch, and Mangal (1997) establish that the effect of technology on performance arises when technology is used to change speed and/or the quality of information processing tasks. The higher the level of intervention, technology may replace the slower human-processing; thus, enabling carrying out the task with a higher level of efficiency.

On this basis, we can argue the following:

H4: The system's level of intervention moderates negatively the effect of the knowledge of the task on the individual performance.

H5: The system's level of intervention moderates positively the effect of the usefulness of information system on the individual performance.

The following graph summarizes the research model.

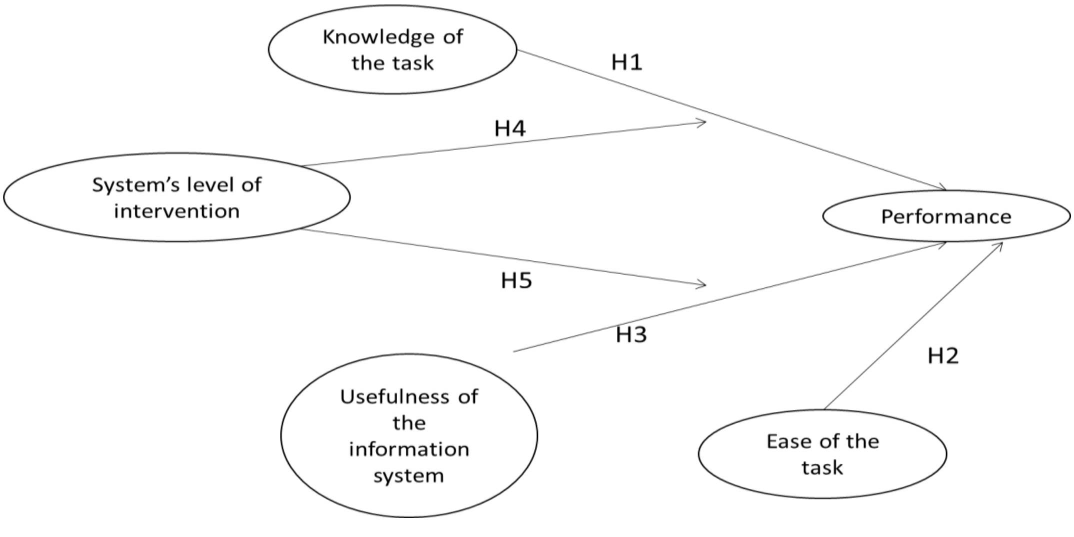

Fig. 2 Research model

3. METHODOLOGY

To examine the proposed effects, a field study was carried out using a questionnaire as a means for gathering data and the partial least square model to analyze the data.

As is common in this type of research, we faced a decision of whether to test our model within a narrowly controlled domain and generalize to a more global domain, or to test the model in a more generalized domain. A more narrowly controlled domain would have removed extraneous influences, but made generalization more difficult. Similarly to Goodhue and Thompson (1995) and Torkzadeh, Chang, and Hardin (2011), we decided to focus at a more generalized domain and to span multiple tasks, multiple areas (finance, logistics, etc.), and multiple organizational settings. Thus, we were testing to see whether a general measure would exhibit the relations suggested by our model. If it did, then we would have found support for our model at a very high level of generalization.

The questionnaire is based on instruments used previously, adapted to the context of the study in the specified domain. The instrument proposed by Muhammed et al. (2009) was used to measure knowledge of the task. ("I have full knowledge of the requirements of my task" or "I have full knowledge of how to carry out my tasks"). Items previously used by Mangos and Steele-Johnson (2001) and Rangarajan, Jones, and Chin (2005) were adapted to measure ease of the task ("Carrying out my tasks is easy" or "Carrying out my tasks is simple"). Items previously used Seddon and Kiew (1997) were adapted to measure usefulness of the information system ("The information system allows me to carry out my tasks more quickly" or "The information system improves the quality of my tasks"). Performance was measured on the basis of an instrument by Muhammed et al. (2009). This instrument investigates the degree of efficiency and effectiveness of the individual through items such as "I carry out my tasks with greater efficiency than expected by my company" or "The quality of my tasks is greater than expected by my company". Measurement of the system's level of intervention was adapted from the scale developed by Muhammed (2007) with items as "To a great extent, my tasks are carried out through the information system " or "To a great extent, the information system supports most of the activities of my tasks".

Likert scales (seven points ranging from totally disagree to totally agree) were used.

Considering that the population was Spanish-speaking and in order to ensure an equivalent translation, back-translation method was used (Brislin & Freimanis 1995).

The questionnaires were distributed to graduate professionals working in companies in Peru. They accepted to collaborate in the research and fulfilled the questionnaires while attending training programs in a well-known Peruvian university. There were 125 usable questionnaires. The professionals worked primarily in the areas of finance (35%) and logistics (30%) at the operative level. Participants used the information system an average of 23 hours a week. On average, participants had been using the information system for 30 months. The enterprise information systems more used were ERP-SAP and ERP-Oracle. The tasks reported by the individuals correspond to typical activities in business processes for their respective areas (e.g. warehouse management, purchase management, invoicing).

4. RESULTS

Participant responses give median and standard deviation values of the constructs as shown in Table 1.

Partial Least Square model was used to analyze the data and the proposed effects. The need to model interactions is a consideration often mentioned in the literature to use Partial Least Square (Chin, Marcolin, & Newsted 2003).

Construct	Median	Standard deviation
Knowledge of the task (KT)	5.7	0.9
Usefulness of the Information System (US)	5.2	1.0
Ease of the task (ET)	4.9	1.2
Level of information system intervention (LSI)	5.2	0.9
Performance (PE)	5.2	0.9

Table 1. Median and standard deviation

Reliability as evaluated with Cronbach-α shows acceptable values, above 0.7. Convergent validity is verified given that all the standardized factorial loadings are significant and greater than or equal to 0.7 (See appendix 1). Discriminant validity is verified given that correlation between a pair of latent variables is less than the square root of the extracted variance of the variable (Table 2). The fit of the measurement model is then evaluated, resulting in the following indicators: APC[1]= 0.26 ($p<0.001$), ARS[2]=0.59 ($p<0.001$) and AVIF[3]=2.008. These values are acceptable according to the values recommended in the literature (Kock 2011).

Construct	Correlations and square root of average variance extracted AVE *					Cronbach α	Composite reliability	Average variance extracted (AVE)
	PE	ET	KT	US	LSI			
PE	*0.91*					0.95	0.96	0.84
ET	0.46	*0.88*				0.86	0.91	0.78
KT	0.70	0.36	*0.92*			0.96	0.97	0.85
US	0.62	0.39	*0.60*	*0.92*		0.94	0.96	0.85
LSI	0.48	0.50	0.54	0.68	*0.87*	0.92	0.94	0.75

Table 2. Correlations, reliability and average variance extracted (AVE)

Note: * Diagonal numbers are the square root of AVE for each construct and off-diagonal numbers are the correlations between constructs

Figure 3 shows the standardized coefficients, the level of significance of the links and the explained variance of performance (58%).

5. DISCUSSION

The principal findings of the study comprise: (1) verifying knowledge of the task, usefulness of the information system and ease of the task which explains performance; and (2) on an empirical basis, system level intervention moderates direct effects of knowledge of the task and information system usefulness.

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[1] Average path coefficient
[2] Average R-squared
[3] Average variance inflation factor

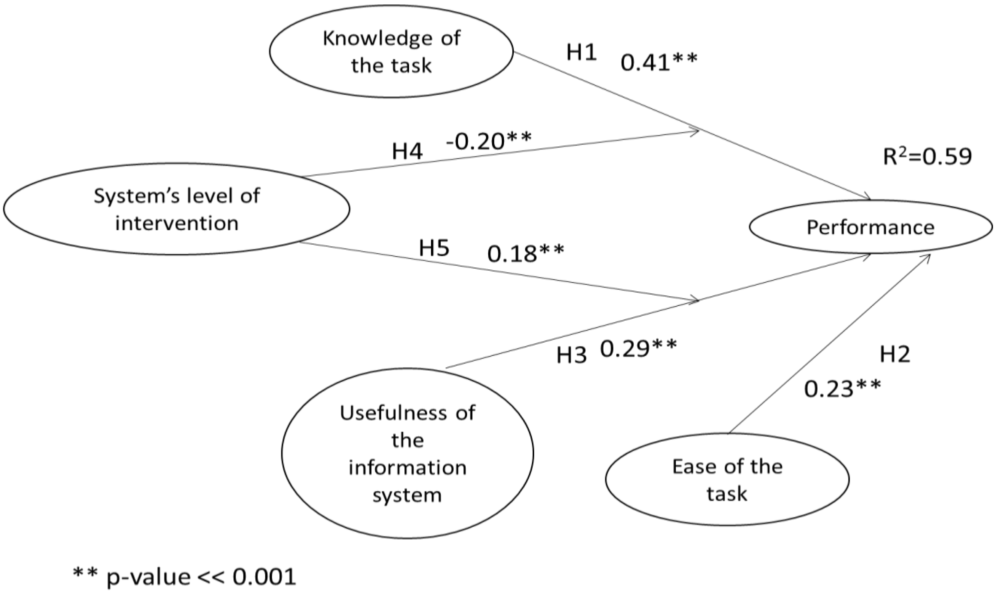

Figure 3. Results

Specifically, the results reflect that knowledge of the task explains performance (H1). This suggests that, provided that the individual has a dominion over work requirements and routines and procedures to be carried out, this person may probably be focused on accomplishing key goals of each task. Therefore, production will increase and defaults will minimize, and these two factors (production increase and default decrease) will have an effect on performance. These results are coherent with prior studies carried out in industrial psychology (Borman et al. 1991; McCloy et al. 1994; Muhammed et al. 2009).

Our study also shows that the usefulness of the system has an impact on performance (H2). This suggests that a system, even though it is a support tool, enables individuals to carry out their activities faster and with higher quality levels, which ultimately have an impact on performance. These results are aligned with prior empirical studies carried out in the field of information systems (Bravo et al. 2015; Parkes 2012).

Additionally, the study reflects that the ease of the task explains performance (H3). This suggests that when the individual verifies that the task is simple and understandable, possibly less mental effort will be required, less time will be invested and fewer errors will be made, which will ultimately contribute to performance. These results are coherent with prior field studies in industrial psychology (Mangos & Steele-Johnson 2001; Maynard & Hakel 1997).

Additionally, the results stated that the system level intervention may have a negative impact on the relationship between knowledge and performance (H4); and may have a positive effect on the relationship between usefulness and performance (H5). This suggests that if the system has a more significant intervention on carrying out tasks, simultaneously, the individual (based on his/her knowledge) may decrease their level of contribution to performance and technology (based on its usefulness) may strengthen its contribution to performance, thus resulting in the replacement effect which is being reviewed in this study. Graphically, this is illustrated (see Figure No.4) by noticing that from lower to higher system intervention levels, knowledge effects decreases (lower slope) and usefulness effects increases (higher slope).

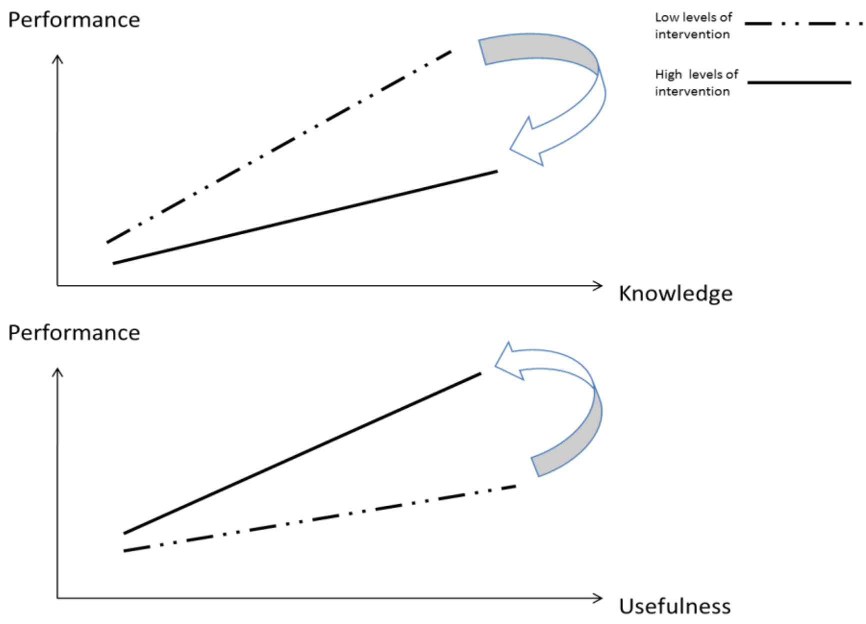

Figure 4. Moderated effects of system intervention levels

Literature contributions are mentioned. In first place, our study emphasizes the role of the individual as an alternative "producer" of technology within a work system as compared to traditional "user" role that interacts with technology (e.g. human-computer interaction literature) and "information consumer" " (e.g. decision maker in the context of Decision Support System). The producer role has different stages: processing transactions, handling data, making decisions, controlling processes, acquiring and disseminating knowledge or creating and innovating. It should be noted that the individual's participation in these stages has decreased simultaneously with the development of technology. Therefore, processing transactions and handling information has clearly been assumed by technology. Technology is not only automated for physical task but also for cognitive tasks, e.g. to solve problems. This study contributes to a higher level of the individual's understanding of this producer role. In second place, an economic approximation has been included to understand the exchanges between an individual and technology as elements that compete in production. It should be noted that there are few studies (Davern & Kamis 2010) that collect this approximation in the literature regarding information systems on an individual level.

References are also made to management contributions. First of all, this study may provide more elements for management to determine the level of intervention that information systems should have (How should the level of automation be determined?). This study shows that there is a replacement effect between production factors (individual and technology) that enable management to use one or more production factors based on costs or availability. Second, this study warns management that higher information system levels may result in knowledge impairment (declarative and procedural). In cases where the higher the intervention levels of technology, a portion of the individual's knowledge may be transferred to technology and no longer used and finally forgotten (Parasuraman et al. 2000 p. 291).

Certain limitations may arise. Our research has had the following limitations. Data was collected at the same point in time and using the same questionnaire; therefore, it is possible that there may be bias because a common method was used. Additionally, individuals that provided data were placed and surveyed within the facilities of a university; even though this process has been applied to prior studies, if these individuals are typical information system users, the results may result very general. For this study, we consider that the participant can be considered as a typical user if he/she was a professional that normally operates with an information system to carry out his/her activities in the organization they are currently employed. The fact that participants on average had been using IS for

30 months could be a limitation, so future studies may consider a wider sample with more senior users.

6. CONCLUSIONS

Organizations should design work taking into consideration that people (based on their knowledge) and technology (based on its usefulness) are substitutable factors each other for production purposes in the context of information systems.

Even more, designers may vary the intensity of the effect of production factors on performance. For this purpose, they can control the level of intervention on tasks. Higher levels of intervention may amplify the effects of usefulness and lessen the effects of knowledge and lower levels of intervention may lessen the effects of usefulness and amplify the effects of knowledge.

Managers should consider the design of the task (i.e. level of automation) as a contingent variable to evaluate individual performance.

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APPENDIX 1 - COMBINED LOADINGS AND CROSS-LOADINGS

	PE_	ET_	KT_	US_	LSI_	LSI_*KT	LSI_*US
PE_1	0.907	-0.078	0.033	0.021	0.056	-0.016	0.026
PE_2	0.906	-0.109	0.024	0.048	0.027	0.003	0.015
PE_3	0.917	0.1	-0.029	0.091	-0.078	-0.011	0.037
PE_4	0.932	0.02	-0.026	-0.117	0.008	0.075	-0.083
PE_5	0.91	0.065	-0.002	-0.041	-0.013	-0.051	0.007
ET_1	0.089	0.868	0.037	-0.009	0.038	0.115	-0.053
ET_2	-0.095	0.862	0.129	-0.026	-0.002	-0.068	0.068
ET_3	0.006	0.918	-0.156	0.033	-0.034	-0.045	-0.014
KT_1	0.015	0.034	0.889	0.082	0.043	-0.07	0.068
KT_2	-0.015	0.059	0.923	0.028	-0.041	-0.057	0.021
KT_3	0.027	-0.081	0.932	0.015	-0.086	0.131	-0.108
KT_4	0.02	-0.037	0.94	-0.156	0.138	-0.013	-0.014
KT_5	-0.047	0.028	0.933	0.036	-0.054	0.005	0.037
US_1	-0.049	0.064	0.205	0.901	-0.078	0.055	-0.042
US_2	-0.044	-0.041	0.017	0.926	-0.045	-0.059	0.053
US_3	0.012	-0.023	-0.112	0.936	0.027	-0.05	0.003
US_4	0.08	0.002	-0.103	0.921	0.094	0.056	-0.015
LSI_1	-0.083	0.161	-0.086	0.154	0.878	-0.031	0.139
LSI_2	-0.033	-0.068	0.183	0.077	0.886	-0.109	-0.025
LSI_3	0.075	-0.028	-0.096	0.099	0.903	-0.013	0.046
LSI_4	-0.032	0.115	-0.098	-0.071	0.878	-0.029	0.062
LSI_5	0.08	-0.201	0.11	-0.294	0.785	0.205	-0.25
LSI_1*KT_1	-0.024	-0.046	-0.101	0.029	0.153	0.789	0.094
LSI_1*KT_2	0.186	-0.066	-0.14	-0.107	0.126	0.846	-0.069
LSI_1*KT_3	-0.012	0.021	0.001	-0.047	0.184	0.86	0.061
LSI_1*KT_4	0.067	-0.009	-0.02	-0.062	0.15	0.859	-0.07
LSI_1*KT_5	0.025	-0.039	-0.003	0.069	0.034	0.825	-0.03
LSI_2*KT_1	0.087	-0.133	-0.097	-0.016	-0.062	0.848	-0.089
LSI_2*KT_2	0.267	-0.146	-0.146	-0.148	-0.068	0.864	-0.177
LSI_2*KT_3	0.101	-0.109	0.07	-0.063	-0.165	0.868	-0.14
LSI_2*KT_4	0.04	-0.069	0.038	-0.061	-0.138	0.901	-0.174
LSI_2*KT_5	0.042	-0.115	0.044	0.065	-0.232	0.875	-0.13

(Cont).

	PE_	ET_	KT_	US_	LSI_	LSI_*KT	LSI_*US
LSI_3*KT_1	-0.035	-0.045	-0.045	-0.003	0.109	0.804	0.148
LSI_3*KT_2	0.18	-0.097	-0.087	-0.153	0.092	0.813	-0.093
LSI_3*KT_3	-0.126	0.067	0.037	0.023	-0.005	0.824	0.076
LSI_3*KT_4	-0.128	0.068	0.077	0.023	-0.007	0.86	0.019
LSI_3*KT_5	-0.089	0.01	0.049	0.151	-0.106	0.85	0.06
LSI_4*KT_1	-0.164	0.225	-0.049	-0.02	0.144	0.81	0.322
LSI_4*KT_2	0.119	0.139	-0.186	-0.041	0.075	0.821	0.102
LSI_4*KT_3	-0.183	0.315	-0.077	0.042	0.04	0.787	0.236
LSI_4*KT_4	-0.144	0.271	-0.039	0.041	0.033	0.831	0.165
LSI_4*KT_5	-0.126	0.23	-0.024	0.188	-0.096	0.819	0.217
LSI_5*KT_1	0.016	-0.16	0.108	-0.002	-0.014	0.772	-0.12
LSI_5*KT_2	0.123	-0.163	0.068	-0.083	-0.009	0.782	-0.244
LSI_5*KT_3	-0.037	-0.059	0.185	0.031	-0.034	0.784	-0.033
LSI_5*KT_4	-0.139	-0.012	0.156	0.006	0.002	0.814	-0.046
LSI_5*KT_4	-0.082	-0.059	0.199	0.157	-0.174	0.794	-0.042
LSI_1*US_1	0.138	0.003	-0.104	-0.174	0.243	0.034	0.858
LSI_1*US_2	0.091	-0.109	-0.126	-0.06	0.213	-0.005	0.834
LSI_1*US_3	0.165	-0.124	-0.088	-0.004	0.055	-0.062	0.893
LSI_1*US_4	0.005	-0.139	0.074	0.003	0.11	-0.083	0.863
LSI_2*US_1	0.088	-0.008	-0.105	-0.09	0.013	0.239	0.865
LSI_2*US_2	0.041	-0.073	-0.087	0.066	-0.141	0.271	0.886
LSI_2*US_3	0.162	-0.053	-0.131	0.033	-0.179	0.227	0.898
LSI_2*US_4	0.033	-0.006	-0.03	0.056	-0.143	0.225	0.915
LSI_3*US_1	0.003	0.048	-0.069	-0.156	0.194	-0.021	0.877
LSI_3*US_2	0.01	0.066	-0.058	-0.098	0.093	-0.075	0.846
LSI_3*US_3	0.024	0.042	-0.041	0.012	-0.05	-0.164	0.899
LSI_3*US_4	-0.105	0.075	0.099	-0.004	-0.016	-0.145	0.865
LSI_4*US_1	-0.123	0.156	-0.035	-0.008	0.132	-0.011	0.905
LSI_4*US_2	-0.169	0.179	-0.029	0.065	0.08	-0.18	0.874
LSI_4*US_3	-0.029	0.09	0.003	0.083	-0.102	-0.201	0.904
LSI_4*US_4	-0.152	0.128	0.118	0.093	-0.071	-0.23	0.864
LSI_5*US_1	-0.084	-0.063	0.21	-0.072	0.028	0.088	0.845
LSI_5*US_2	-0.032	-0.103	0.105	0.059	-0.078	0.099	0.798
LSI_5*US_3	-0.031	-0.101	0.135	0.125	-0.224	-0.03	0.83
LSI_5*US_4	-0.045	-0.033	0.196	0.067	-0.154	0.023	0.821