

Information systems – development tools for metalworking enterprises

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1. Small and Medium-sized Industries (SMI) and the Information Systems (IS).

Venezuelan government reports, as it usually happens worldwide, confirm that the highest employment rate and goods & services figures are provided to the country by Small and Medium-sized Enterprises (SME); especially, by the SMI sector. The Law for the Promotion and Development of the SMI alleges, among other factors affecting the potential growth of the sector, the scarce use of information made by these enterprises; thus summoning efforts to support their informational and technological development. Therefore, government has created the Institute for the Development of the SMI (INAPYMI) and called upon the Ministry of Science and Technology to accomplish these goals.

The first phase of the present study is to analyze the end-user perception of the information quality, IS quality, IS services quality, and IS usage as major independent variables for IS end-user satisfaction, which is considered, by many authors, the main dimension for IS success. Hence, this first step responds to the fact that without end-user satisfaction with there IS no use of them and no benefits would follow. The research question is: What is the level of end-user satisfaction with their IS and how they perceive the main variables related to such a perception? The object of study is conformed by a representative population of the SMI of Ciudad Guayana, Bolivar State, Venezuela, such as the medium-sized industrial metalworking enterprises. This research is also related to a PhD thesis. A fieldwork including quantitative and qualitative methods is carried out, beginning with the quantitative part of this phase of the project, which is presented in this paper.

Managerial and some technical issues are taken into account in the project. Therefore, the fieldwork work also includes the gathering of additional information on the subject and the identification of weaknesses and opportunities in the IS area. An objective is that management in this industrial sector and local universities can find new grounds for higher cooperation. A practical goal aims to the designing of better IS and IT practices, strategies, management and technical support leading to a higher individual and organizational performances, via the IT/IS tools, leading to boost the economic development of the sector.

For this study, SMI are classified according to the United Nation's code for these type of enterprises. For international reference, table 1 shows the Uniform Industrial Code Rev3, provided by the Venezuelan National Statistics Institute (INE) (2009):

(International) Uniform Industrial Code - UIC. Rev. 3.		
Division 28	Making of metal products, except machinery and equipment.	
	281	Making of metal products for structural use, containers, deposits, and vapor generators.
	289	Making of other metal products; metalworking service activities.
Division 29	Making of machinery and equipment N.C.P.	
	291	Making of general use machinery.
	292	Making of special use machinery.

Table 1. Uniform Industrial Code. Venezuelan National Statistics Institute (INE) 2009.

Likewise, table 2 shows the ranking issued by the INE (2009) and used in this research, in the selection of its object of study.

Type	Employment layer	People Employed (PE)
Big Industry	1	PE > 100
Medium Industry Superior	2	51 ≤ PE ≤ 100
Medium Industry Inferior	3	21 ≤ PE ≤ 50
Small Industry	4	5 ≤ PE ≤ 20

Table 2. Ranking of industries. Venezuelan National Statistics Institute (INE) 2009.

2. Information Systems (IS) as tools for development in the SME sector.

The undeniable benefits derived from an efficient use of IS, which should translate into a higher individual and organizational performances, makes IS to be considered as vital tools for the economic development, the generation of competitive advantages and a higher productivity in organizations. The focus is centered on a strategic sector for regional and national development in Venezuela (PDESN, 2007), (PNCTI, 2007). As an example, it is deemed that 90% of SMEs, on average, in Latin American countries, provide employment for approximately 70% of the labor market and contribute to 20% to 30% of GNP (Ackoff, 2004 from Guaita, 2008). The sound growth of this type of enterprises is crucial and the potentiality of IT/IS tools to support such a growth is well-known. Globalization continues to bring more and new challenges, thus demanding better use and management of IT/IS tools. SMEs are firms that share some similar characteristics, including those referred to their investments in IT/IS assets; especially in development countries. But, not for having more technology a firm is better off than its competitors or is improving its performance.

An IS is defined as a set of interrelated elements, including hardware, software and users, in order to capture, storage, process and deploy data and information (Laudon & Laudon, 2004). However, this paper also includes another meaning of the term IS, which refers to the business functionality supported by the software or, specifically, the application software. Characteristic features of IT, such as high speed of capture, processing and delivery of information are key success factors, but in the end what really counts is the outcome. IT tools must not only support critical processes, administrative functions and tasks performed on a regular basis, but also provide useful information and create competitive advantages (Cornella, 1997).

2.1. Updated model of DeLone and McClean (D&M)

This research phase is based on the success dimensions of the model of DeLone and McLean (1992, 2002, 2003), shown in figure 1, which has been used heavily in over a hundred studies, and one of the most demanded model in recent similar works. This subject matter has been studied by these authors since 1992. To assess the IS effectiveness, which this model equates to IS success, it is critical to also measure some related organizational issues (Rai, A. et al.,

2002), (Wixom, B.H., Todd, P.A., 2002). Another model used to guide the quantitative and interpretive views is the Michael Myers' model of qualitative IS research (Myers, M. 2007 2008)..

Not only a good amount of studies on the subject have used the D&M model as a guide, but also some of them have extended the model (Medina 2006). This is also the case with a doctoral thesis that continues the present research, but applied to big enterprises. (Calderón 2008). More research on the dependent variable user satisfaction, what it implies and its related variables is deemed key to the implementation and sustained usefulness of IS, at any type of firms. Hence, this work pursues to analyze the variables, and their relationships, presented by the D&M's model.

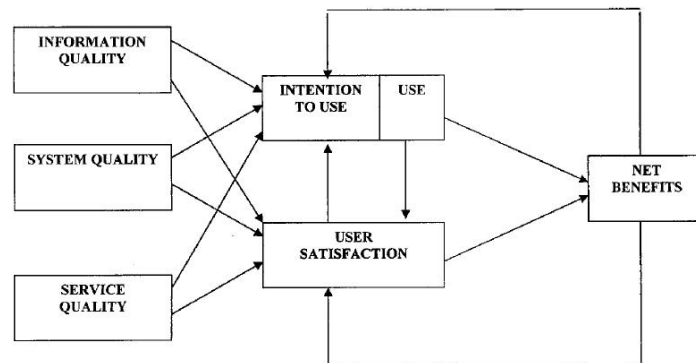


Figure 1. Updated D&M IS Success Model.

2.1.1 “End-user satisfaction” as the main dimension for IS success.

The efficient use of IT/IS is considered a vital factor for economic development (Hummel, 2001), for the generation of competitive advantages (Cohén & Asín, 2004), and for productivity (Kotler, et al., 2004). However, these aspects are influenced by the abilities and acceptability of users (Torkzadeh and Lee, 2003) because, being users the main responsible for the use of their IS and IT, personal traits are deemed a major ingredient for the success of IS (Ibid.). But, unless users can derive tangible benefits from their IS, their intention of use will be low (Shin, 2002). Another reason for “user satisfaction” to be a sound measure of IS success widely accepted has been that users are the judges who decide to what degree their informational needs are being taken care of by their IS (Mahmood et al., 2000 2001) (Jiang et al., 2001).

At the same time, the construct “end-user satisfaction” should translate itself into cause and effect of the heightening of the individual and group performances by helping create and maintain value IS. Human and organizational aspects of IT/IS performance appraisal and evaluation are at the center of the study. Due to its significance and complexity in any organization, the Human Resources department and its principal IS, have been selected for the study. In a next stage, this work pursues to analyze the current level of investment in IT/IS, as well as the information architecture and IT infrastructure of such enterprises. Also, due to the worldwide relevance of SMEs, as the organizations with the highest national rate of employment and potential for sustainable development, especially in third world countries, this study is deemed to be of interest to researchers and practitioners in the field.

2.2. Fieldwork in the metalworking SMI of Ciudad Guayana. Payroll IS.

As mentioned above, this work covers the population of 35 medium-sized metalworking enterprises members of the Association of Metal-mechanic and Metallurgic Industrials (AIMM 2009) and the Chamber of Industrials and Miners of Guayana, Venezuela's most important non-oil-producer region. Statistical techniques are applied to the organized data

which, methodologically belongs to the population but, because these statistical tools are being applied in a fixed space and time span, from a statistical viewpoint the data is being treated as a sample.

As stated, the study focuses on the Human Resources departments and their Payroll IS for three reasons: 1) all the firms studied have it, 2) it is a critical and complex IS which shares similar but at the same time particular characteristics, in a variety of like organizations, and 3) it fits well for the analysis to be undertaken. Regarding the data collection techniques utilized, a structured survey is applied directly to IS users of the payroll and HR IS. This is made by using an interval-scale Likert type questionnaire consisting of 62 test items, whose reliability was measure by Cronbach’s alpha of 0.906. The first 8 items are excluded for they do not belong in the D&M model and are reserved for future use. A semi-structured interview is used for data collection from key informants (upper management). Comments and observations are also urged in the questionnaire. As to the analysis techniques, quantitative data is analyzed by descriptive and correlational statistical methods, with the variables proposed by the D&M model. The variables comprising the user satisfaction dimension are analyzed in order to test the tacit hypothesis: “the higher the quality of the information, the quality of the IS, and the quality of the IS services, the higher the average value of use and satisfaction with the IS, which should translate into better levels of personal and organizational performance.” Table 3 shows the six independent variables in the D&M model to be used. The quantity of statements (test items) assigned to each variable can be seen in the last column:

Var. #	Name:	Items:
1	Use of the IS.	09 a 13
2	Quality of the information received from the IS.	14 a 22
3	Quality of the IS, as a tool.	23 a 35
4	Quality of the services rendered by specialists in IT/IS.	36 a 47
5	Personal performance, due to the IS.	48 a 54
6	Organizational performance, due to the IS.	55 a 61

Table 3. Items per variable.

Descriptive statistics and correlations between these independent variables and the dependent variable “user satisfaction”, according to the D&M model, are analyzed. Apart from the use of summative scales, given their relevance, some Likert items are analyzed individually.

3. Results

All Likert items have a score from 1 to 5 where low values tend to 1 and high values tend to 5. Acceptable values are considered to be those over 3 –as all of them are. Table 4 shows the variables of the D&M’s revised model and their respective statistical descriptive measurements (arithmetic mean). Except for the variable use of the IS, a representative –or summary– item (column 3) was included in each group. This table shows how close the value of the means and each corresponding value are. Also a summary item was added at the end for the overall satisfaction, measuring 4.48, that compared with the average of all means (3.97) shows a difference of only 13%.

Variables	Mean	Rep. Item.	Std. Dev.
Use of the IS	4.10	---	0.522
Quality of the information provided by the IS	4.35	4.18	0.285
Quality of the IS, as a tool	4.26	4.64	0.449
Quality of the services provided by technicians	3.95	4.36	0.818
Personal performance	3.97	3.94	0.474
Organizational (group) performance	3.70	3.64	0.414

Table 4. Descriptive statistics.

The results of the regression are shown in table 5. Following the D&M model, whose compliance with reality is to be verified, user satisfaction has been designed as the dependent variable. The other variables of the model represent the independent variables. By using the statistical software SPSS, the addition method was utilized as the procedure to sequentially insert all predictors, one at a time. Table 5 includes the six resulting models from the regression, based on the six predictor variables. The values of R^2 and the significance of the change in F, indicate that the dependent variable is best predicted by model number 6.

Model	R	R2	Std. Err.	R2 Change	F Change	df1	df2	Sig. F Change
1	.194a	.038	.506	.038	1.217	1	31	.278
2	.706 b	.498	.371	.460	27.482	1	30	.000
3	.758 c	.575	.348	.077	5.252	1	29	.029
4	.765d	.585	.349	.010	0.706	1	28	.408
5	.791e	.626	.338	.040	2.903	1	27	.100
6	.791f	.626	.344	.000	.017	1	26	.896

Table 5. Models.

- a Predictors: (Constante), Use of the IS.
- b Predictors: (Constante), Use of the IS, Quality of information.
- c Predictors: (Constante), Use of the IS, Quality of information, Quality of the IS.
- d Predictors: (Constante), Use of the IS, Quality of information, Quality of the IS, Quality of service.
- e Predictors: (Constante), Use of the IS, Quality of information, Quality of the IS, Quality of service, Personal performance.
- f Predictors: (Constante), Use of the IS, Quality of information, Quality of the IS, Quality of service, Personal performance, Group performance.
- g Dependent Variable: User satisfaction.

Table 6 shows the regression model that best fits the data.

Model	Included variables	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
6	(Constant)	-0,477	1,069		-0,447	0,659
	Use of IS	-0,288	0,154	-0,296	-1,868	0,073
	Quality of Information	0,908	0,279	0,510	3,248	0,003
	Quality of the IS	0,091	0,238	0,081	0,385	0,704
	Quality of Service	0,157	0,134	0,252	1,167	0,254
	Personal Performance	0,272	0,266	0,254	1,022	0,316
	Group Performance	0,027	0,209	0,031	0,132	0,896

Table 6. Coefficients.

The resulting linear equation, that best explains the data for model number 6, is:

$$y = -0.477 + (\beta_1 \times x_a) + (\beta_2 \times x_b) + (\beta_3 \times x_c) + (\beta_4 \times x_d) + (\beta_5 \times x_e) + (\beta_6 \times x_f)$$

Figure 2, represents the correlations between user satisfaction and the predictor variables:

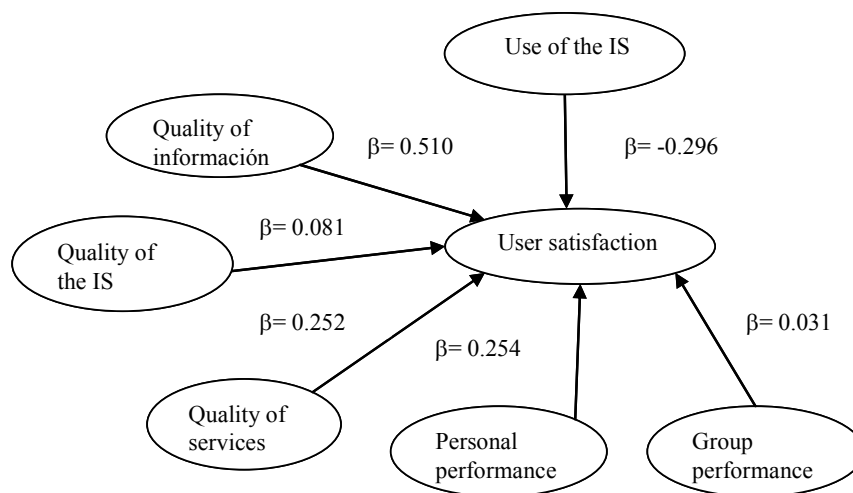


Figure 2. Standardized Coefficients of Beta.

4. Conclusions

With a mean of 4.48 for item 62, the first part of the research question can be answered: total satisfaction with the IT/IS is high. Likewise, perception of related independent variables is also high, answering the second half of the question. It can be observed that the highest correlation comes from the variable quality of information. This supports one of the key affirmations, to be upheld in the related doctoral thesis, stating that users are most interested in the quality of the information they need to do their work. Even to the point of forgiving deficiencies in other important variables. Perhaps the variable use of the IS should be blended with user satisfaction, in accordance with some authors who allege that one leads to the other. The variable personal performance also has a high correlation with user satisfaction, showing that users think they are obtaining quality information that increases their individual work production. Quality of services follows in importance, meaning that keeping the IS up and running is vital. On the other hand, it is necessary to highlight the fact that quality of the IS –

as a tool– does not exhibit major impact. This can be interpreted as a sign that users are willing to waive secondary aspects, such as ease of use, processing speed, or a nice window-type user interface, for useful quality information. The analysis reflects that users were not able to estimate how the IS has affected organizational performance. Many of them marked number 3, the undecided value of the scale. These findings are favorable, considering that the Payroll and HR IS contributes heavily to the information demanded, both internally and externally, which is useful for the control and development of the human resources of the enterprise.

We conclude that the D&M model is validated at the SMI in the metalworking sector, thus signaling a starting point for further research and improvements in the Human Resources area of the surveyed firms. Similar studies in other organizational areas and in other enterprises are deemed to be of interest for additional knowledge of the subject matter. An analysis of other data obtained in the questionnaire reveals that over 80% of users are women; over 90% use the same IS brand, which will allow additional aspects to study; over 85% stated that they have to resort to an electronic spread sheet software to complement incomplete data or prepare reports. Also, many users indicated they would like to have more functionality from the IS. More than 95% of the firms do not use free nor open code software. New stages of this work will deepen into these as well as other relevant aspects on the subject.

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