

IT Innovation and Firm's Sustainable Performance: The Intermediary Role of Organizational Agility – An Empirical Study

Mohamed Amine Marhraoui

TIME laboratory, ENSIAS Engineering School, Mohammed V University in Rabat, Morocco
Email: mohamed-amine_marhraoui1@um5.ac.ma

Abdellah El Manouar

TIME laboratory, ENSIAS Engineering School, Mohammed V University in Rabat, Morocco
Email: a.elmanouar@um5s.net.ma

Received: 01 December 2017; Accepted: 19 January 2018; Published: 08 May 2018

Abstract—Both small and large companies are facing tough competition in today's rapidly changing environment. They should be able to adapt continuously to these changes and to exploit them as opportunities of development. Firms should then innovate in order to gain sustainable advantage, by proposing adequate products and services allowing them to increase market shares and sustain their growth. Disruptive technologies are thus adopted in order to conceive innovative products, to develop a new use of existing products/services or to optimize processes. In this article, we describe our theoretical framework and its main constructs. It presents the direct effect of information technology innovation on economic, social and environmental performance. Moreover, our proposed framework focuses on the intermediary role of organizational agility. In addition, the main findings of our quantitative study based on the analysis of survey data from 103 participants are highlighted. After verifying the validity and reliability of our questionnaire results, the framework's hypotheses are tested using partial least squares path modeling method.

Index Terms—IT innovation, organizational agility, economic performance, social performance, environmental performance.

I. INTRODUCTION

The pace of change has increased rapidly in today's environment. New regulations have been put in place for compliance and security issues. Markets are globalized and low cost firms/countries increase competition allowing them to take a significant market share in traditional markets like automobile industry and textile.

Innovation is not a choice for companies. It is an obligation in order to survive for competition. Firms which don't propose new products/services, creative customer experience or innovative solutions cannot compete in a globalized market. Companies should

embrace innovation and particularly adopt up-to-date technologies in order to propose added-value products for their commercial development, to improve their processes for higher internal efficiency and to respect social and ecological environment.

These latter are among the most important concerns of current companies which are devoted to sustain their development. They are more concerned about the needs of all stakeholders by aiming economic growth while preserving environment and promoting social development. Sustainability is then embedded in firm's strategy and specific resources are allocated as to achieve one or some of the sustainable development goals (SDG).

As listed by the United Nations, there are 17 SDGs which propose to companies a framework for segmenting and prioritizing sustainable goals like eradicating poverty and inequalities in order to preserve or enhance profits [1].

In this paper, we focus on the impact of information technology (IT) innovation on firm's sustainable performance. We conduct an empirical study based on a survey in order to verify the theoretical hypotheses.

This paper is organized as follow. Section two is devoted to the description of the adopted methodology and the main constructs/hypotheses of the proposed framework. In section three, we describe the main findings of our empirical study. After highlighting the validity of the results through factorial analysis, we use structural equation modeling in order to test the significance of the model hypotheses. Finally, we present a brief conclusion and our main research perspectives.

II. THE PROPOSED FRAMEWORK

A. Methodology and key concepts

This work is the continuity of the paper which presents the theoretical framework of the study [2] (Fig. 1 below).

It is based on the inductive/deductive methodology as described by Mouchot [3].

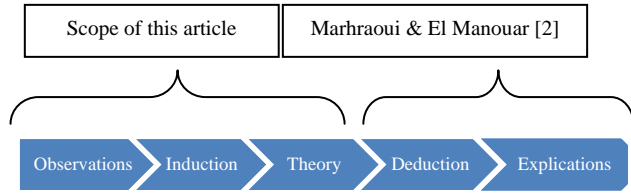


Fig. 1. The inductive/deductive methodology (Mouchot [3])

Indeed, it is based on a comparative study across two different sectors:

1. Telecommunications operators /Over-The-Top(OTTs).
2. Banks /Fintechs.

According to the observations, OTTs (like WhatsApp) have grown rapidly during the last ten years and have gained market share (SMS market for example) to traditional telecommunications operators.

In addition, new Fintechs are able to propose tailored and low cost solutions to customers and have a better time to market in comparison to banks.

The analysis of these observations has allowed formulating the research question and the main hypotheses.

Thus, the research question of the study is: can we generalize that agility and rapid IT innovation are two enablers for firms’ sustainable performance? And how can agility play an intermediary role?

IT innovation is related to the adoption of advanced systems and high performing standards in order to conceive new disruptive products or incremental innovative products for new uses [4].

It can also be related to the use of IT in the introduction of new or optimized production methods for delivering services [5].

Organizational agility is the combination of speed, flexibility, pro-activity, quality and profitability. It is completed through the integration of reconfigurable resources, best practices and knowledge management in order to deliver the right products and services to customers in a changing environment [6].

Furthermore, in this article, we study sustainable performance from a triple bottom line (TBL) perspective. Thus, we distinguish economic, environmental and social performance according to GRI (Global Reporting Initiative) guidelines [7].

B. Framework description

The theoretical framework as per Marhraoui & El Manouar [2] is the following (Fig. 2):

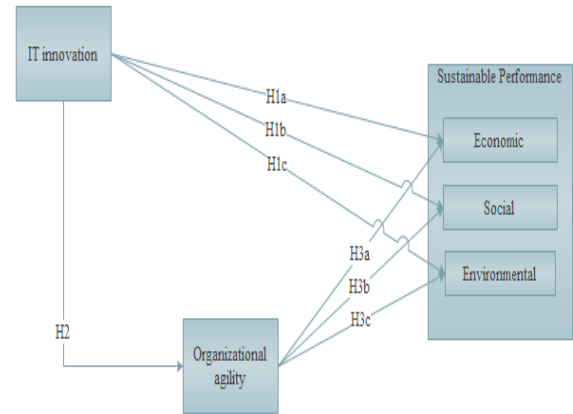


Fig.2. Our proposed framework

The framework’s hypotheses are summarized in table 1 below:

Table 1. Description of the framework hypotheses

Hypothesis	Description
H1a	Firms adopting cutting edge IT innovation enhance their economic performance
H1b	Firms adopting cutting edge IT innovation enhance their social performance
H1c	Firms adopting cutting edge IT innovation enhance their environmental performance
H2	Firms adopting cutting edge IT innovation are more agile
H3a	The more the firm is agile the more it is economically performing
H3b	The more the firm is agile the more it is socially performing
H3c	The more the firm is agile the more it is environmentally performing

III. EMPIRICAL STUDY

In order to verify the hypotheses of our proposed model, we conducted an empirical study. We’ve adopted a quantitative method based on a survey for measuring the impact of the use of IT innovation in order to enhance firm’s sustainable performance and the intermediary role of organizational agility.

Hereafter, we present the data collection method, the sample characteristics, the reliability/validity of the study and the hypotheses verification.

A. Data collection and sample characteristics

The questionnaire was sent to an initial database of one thousand trusted contacts holding different positions in SMEs and multinational companies in different sectors (banking, IT, industry, consulting ...). This is in order to ensure the variation of the variables and to facilitate the generalization of the findings.

In order to ensure reliable contacts, the database was provided by an international training/consulting company.

We received 103 responses which represents a response rate of about 10.3%.The valid questionnaires were collected during the third quarter of 2017.

The respondents are mainly from Moroccan companies (57. 28%). Moreover, we received responses from American countries (USA, Canada) and European countries (France, Germany, Austria, Hungary).

The remaining responses represent other countries in Asia and Africa. The detail of countries respondents is listed in table 2 below.

Table 2. Sample Characteristics (N=103)

Measure	Item	Percentage
Gender	Man	62.14%
	Women	37.86%
Age	18-29	31.07%
	30-44	38.83%
	45-59	25.24%
	60-74	4.85%
Position	Chief Executive Officer	7.77%
	Board Member	5.83%
	Manager	53.40%
	Non manager	33.01%
Size	< 10	14.56%
	Between 10 and 100	20.39%
	Between 100 and 5000	32.04%
	+5000	33.01%
Sector	Retail	7.77%
	Banking	14.56%
	Consulting	10.68%
	Construction	2.91%
	IT	17.48%
	Energy	12.62%
	Industry	23.30%
	Others	10.68%
Country	Morocco	57.28%
	France	8.74%
	USA	8.74%
	Italy	4.85%
	Germany	3.88%
	Canada	1.94%
	Austria	1.94%
	Hungary	1.94%
	Others	10.68%

B. Conctructs and corresponding items

The main constructs and the corresponding items are described in table 3 below.

Table 3. The constructs and corresponding items

Construct	Item	Literature
IT innovation	INN1: use of cloud computing in order to store data or access to shared resources	Wladawsky-Berger [4]
	INN2: employees equipped with mobiles and dedicated work applications	Tank [8] Barret et al. [9]
	INN3: use of groupware and workflow tools in order to enhance collaboration	Manyika et al. [10] Sambamurthy [11]
	INN4: business Analytics based on a big data initiative/project	Baalghusun & Qureshi [12]
	INN5: use of new e-learning systems	
Organizational agility	OA1: rapidly adapt to political and regulatory changes	Sambamurthy et al.[13] Covey et al.[14] Markides [15] Brown and Eisenhardt [16]
	OA2: involve suppliers in the proposition of higher added value products/services	
	OA3: integrate reconfigurable resources in order to be flexible to change	
	OA4: adopt new organizational structures: self-management teams, holacracy, virtual teams...	
Economic performance	SPEC1: total/net income	Ding [17]
	SPEC2: Amount of sales	
	SPEC3: Earning per share	
Environmental performance	SPEN1:energy/water consumption	Székely, and Knirsch [18] Bieker [19]
	SPEN2: waste	
	SPEN3: emission of gases	
Social performance	SPSO1: work conditions	Trébucq [20]
	SPSO2: community initiatives and donations	
	SPSO3: % suppliers that fulfill social criteria	

C. Reliability and validity

- Reliability/Internal consistency using Cronbach's alpha and Guttmman's lambda-2 :

In order to assess the reliability of our questionnaire, we used the Cronbach's alpha and Guttmman's lambda-2.

Indeed, the Cronbach's alpha is related to the extent to which a set of items measures a single unidimensional latent construct. It will generally increase as the correlations among test items increase.

For our questionnaire, the value of Cronbach's Alpha is nearly 0.90 which is an excellent index for internal consistency according to Bland and Altman [21] (See Fig. 3 below).

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
,899	,900	18

Fig. 3. Internal reliability using Cronbach's Alpha

Moreover, in order to ensure a high internal reliability, we used the Guttman's lambda-2 which is the second in a series of 6 lambdas proposed by Guttman [22] in 1945.

We use the lambda-2 as Guttman has proved that among these 6 forms, only lambda-2 is closer to the true reliability [23].

The value of lambda-2 which is nearly 0.9 confirms the internal reliability of our questionnaire (Fig. 4 below) [22].

Lambda	1	,849
	2	,902
	3	,899
	4	,720
	5	,879
	6	,931
N of Items		18

Fig. 4. Internal reliability using Guttman's lambda-2

➤ KMO and Bartlett's Test

Then we conducted a sample sufficiency test and a sphericity test.

Indeed, we used KMO (Kaiser-Meyer-Olkin) index which measures proportion of variance among variables that might be common variance.

Using IBM SPSS Statistics, we have a value of 0.828 (Fig. 5 below) which represents a high level of sampling adequacy [24].

Also, the Bartlett's test of sphericity (Fig. 5 below) presents the validity and suitability of the collected responses to the problem being addressed through the survey. Considering a 95% level of significance ($\alpha = 0.05$), the p-value (Sig.) of .000 is under 0.05, and therefore the factor analysis is valid [25].

We conclude that there may be statistically significant interrelationship between variables.

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,828
Bartlett's Test of Sphericity	Approx. Chi-Square	869,477
	df	153
	Sig.	,000

Fig. 5. KMO and Bartlett's Test

➤ Confirmatory factor analysis (CFA) :

In order to test how well the measured variables represent the constructs of our model, we conducted a confirmatory factor analysis (CFA).

CFA is a statistical method used by a set of researchers in order to confirm if the observed variables are representing a combination of unobserved constructs called factors or latent variables [26].

CFA is usually adopted in social sciences (especially in psychology) and in management/marketing studies.

We used AMOS software in order to test the pre-specified relationships. Fig. 6 below presents the results of the CFA: factor loadings, factor covariances and error variances.

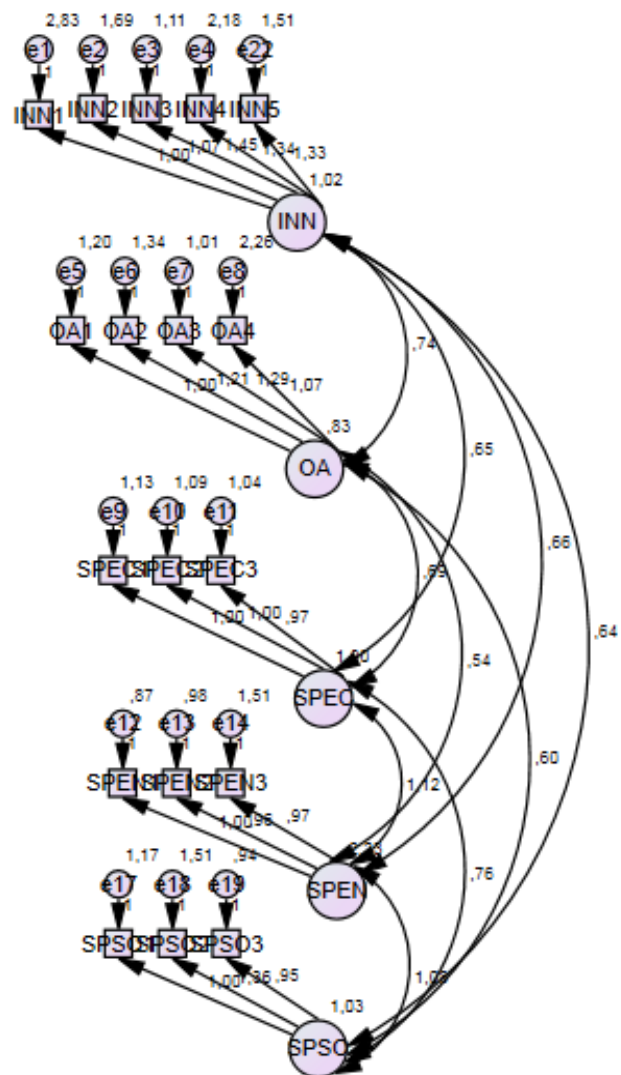


Fig. 6. The confirmatory factor analysis results

The goodness of fit of the model was measured through a set of indices as described in table 4 below:

We can conclude that the main indices (CMIN/df, RMSEA, CFI, and TLI) are acceptable and confirm a good fit of our model.

D. Hypotheses test

In order to verify the hypotheses of our model, we used a partial least squares path modeling method (PLS). This latter is a variance-based structural equation modeling (SEM) technique which allows estimating cause-effect relationship models containing latent variables.

Table 4. Measures used for assessing the fit of our model

Measure	Definition	Value	Signification in comparison to threshold
CMIN/df	The CMIN represents the chi-square goodness fit or discrepancy function. df is the degree of freedom. The criterion for acceptance is less than 2 [27]	1.490	Acceptable : less than 2
RMSEA (Root Mean Square Error of Approximation)	A measure of goodness of fit for statistical models [28]	0.069	Acceptable : below 0.10
CFI (Comparative Fit Index)	Examining the discrepancy between the data and the hypothesized model [29]	0.921	Good : upper to 0.90
TLI (Tucker-Lewis Index)	Indicate how much better a model fits the data compared to a baseline model where all variables are uncorrelated [30]	0.904	Good : upper to 0.90

PLS was introduced by the Swedish statistician Herman Wold [31] as an econometric technique. Otherwise, the main applications of this method are in chemistry and chemometrics.

The PLS path model includes inner and outer models. The inner model describes the relationships between latent variables (factors).

However, the outer model is related to the relationships between the latent variables and the observed variables [32] (Fig.7 below).

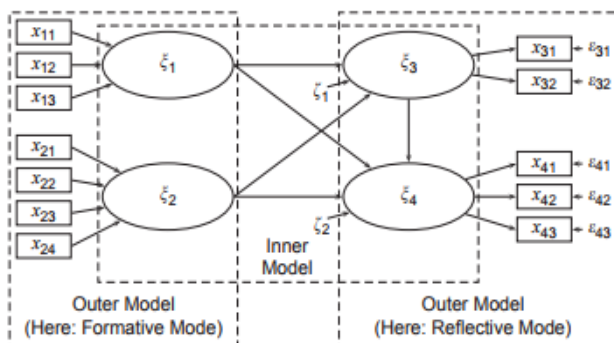


Fig. 7. Example of a PLS Path Model (Henseler et al., 2009)

In our case, the inner model is constituted by the 5 factors: IT innovation, organizational agility, economic performance, social performance and environmental performance. The related observed variables are described in table 3.

Using SmartPLS software, we calculated the PLS results on our model (Fig.8 below) with a top criterion of (10^{-7}) and a maximum number of iterations of 300 as advocated by Ringle et al. [33].

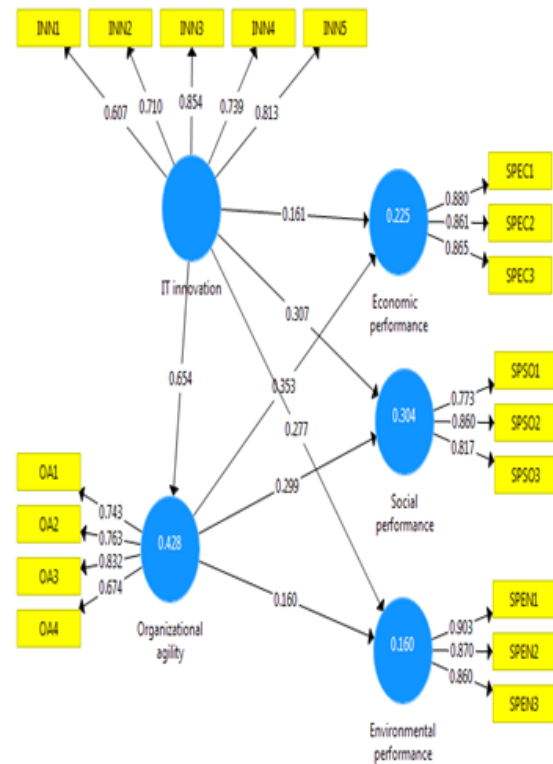


Fig. 8. The PLS-SEM results on our model

The results for our inner model are related to the cause-effect relationships between the exogenous latent variable (IT innovation) and the other endogenous latent variables (Economic, social and environmental performance) through the mediating variable (Organizational agility).

Considering the standardized path coefficient placed on the arrows, the direct effects are described in Fig. 9 below.

We can conclude that IT innovation has a significant impact on organizational agility (0.654). This supports our second hypothesis H2.

Also, organizational agility has a direct positive effect respectively on economic (0.353), social (0.299) and environmental (0.160) performance. This confirms H3a, H3b and H3c hypotheses: the more the firm is agile, the more it is sustainably performing.

Moreover, IT innovation has respectively a positive direct effect on social, environmental and economic performance of (0.307), (0.277) and (0.161).

H1a, H1b and H1c hypotheses are then validated. Also, we highlight the fact that the first concern of IT innovation is resolving social and environmental issues and then allowing firms to make profits.

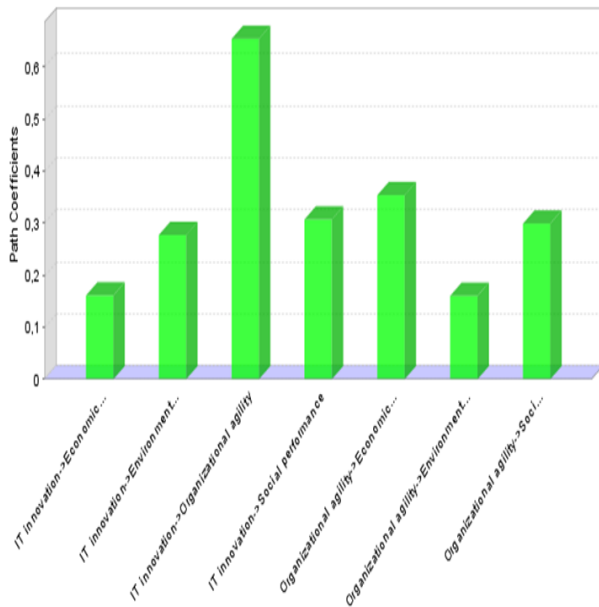


Fig. 9. Comparison of our model’s path coefficients

Nevertheless, IT innovation has greater indirect effect on economic (0.231) rather than on social (0.196) and environmental (0.105) performance (as mentioned in table 5 below).

This means that firms adopting IT innovation are more economically performing when they are agile.

Table 5. Indirect effects

	Indirect effect
IT innovation ->Organizational agility -> Economic performance	0.231
IT innovation ->Organizational agility -> Environmental performance	0.105
IT innovation ->Organizational agility -> Social performance	0.196

In conclusion, IT innovation has a total impact on sustainable performance, which is the sum of direct and indirect effects (Table 6 below):

Table 6. The total effect of IT innovation on sustainable performance

	Total effect of IT innovation
On economic performance	$0.654 \times 0.353 + 0.161 = 0.391$
On social performance	$0.654 \times 0.299 + 0.307 = 0.502$
On environmental performance	$0.654 \times 0.16 + 0.277 = 0.381$

The greatest total impact is on social performance, then on economic and environmental performance.

IV. CONCLUSION AND RESEARCH PERSPECTIVES

Through this empirical study, the importance of adopting IT innovation is highlighted. Indeed, IT innovation allows companies to enhance their sustainable performance either directly or indirectly by increasing their agility’s level.

Future research will focus on a specific sector or country and enlarge the sample size. Also, we will add other parameters which may impact the agility and firm’s sustainable performance.

REFERENCES

- [1] B. Chakravorti, “How Companies Can Champion Sustainable Development.” *Harvard Business Review*. March 14, 2017. <https://hbr.org/2017/03/how-companies-can-champion-sustainable-development>.
- [2] M. A. Marhraoui and A. El Manouar, “IT innovation and firm’s sustainable performance: The mediating role of organizational agility.” *In the 9th International Conference on Information Management and Engineering (ICIME 2017)*, in press.
- [3] C. Mouchot, *Méthodologie économique*. Seuil, 2003.
- [4] I. Wladawsky-Berger, “IT-based Innovation in the 21st Century” *Stanford EE Computer Systems Colloquium*, 2007.
- [5] A. Y. Obeng and P. L. Mkhize, “Impact of IS Strategy and Technological Innovation Strategic Alignment on Firm Performance” *International Journal of Information Technology and Computer Science(IJITCS)*, vol. 9, No. 8, 2017, pp.68-84. DOI: 10.5815/ijitcs.2017.08.08
- [6] Y. Y., Yusuf, M. Sarhadi, and A., Gunasekaran, “Agile Manufacturing:: The Drivers, Concepts and Attributes.” *International Journal of Production Economics*, vol. 62, No. 1–2, 1999, pp. 33-43.
- [7] GRI (Global Reporting Initiative), *Sustainability reporting guidelines*, www.globalreporting.org, 2002.
- [8] D., Tank, M., “Enable better and timelier decision-making using real-time business intelligence system.” *International Journal of Information Engineering and Electronic Business*, vol. 7, no 1, 2015, pp. 43.
- [9] M., Barrett, E., Davidson., J., JPrabhu and S. L., Vargo, “Service Innovation in the Digital Age: Key Contributions and Future Directions.” *MIS Q.*, vol. 39, No. 1, 2015, pp. 135–154.
- [10] J., Manyika, M., Chui, J., Bughin, R., Dobbs, P., Bisson, and A., Marrs, “Disruptive Technologies: Advances That Will Transform Life, Business, and the Global Economy” *McKinsey & Company*, 2017.
- [11] V., Sambamurthy, “Guiding the Digital Transformation of Organizations” *Tallahassee, FL: Legerity Digital Press*, 2012.
- [12] A. O. Baalghusun and M. R. J. Qureshi, “A Novel Model for Cloud Based Mobile Learning System”, *IJIEEB*, vol.6, no.6, 2014, pp.40-46. DOI: 10.5815/ijieeb.2014.06.05
- [13] V. Sambamurthy, A Bharadwaj and V. Grover, “Shaping agility through digital options: reconceptualizing the role of information technology in contemporary firms” *MIS Quarterly*, vol. 27, No. 2, 2003, pp. 237–263.

- [14] E. Overby, A. Bharadwaj, and V., Sambamurthy, "Enterprise agility and the enabling role of information technology" *European Journal of Information Systems*, Vol. 15, No. 2, 2006, pp. 120-131.
- [15] C. Markides "Disruptive Innovation; In need of Better Theory" *The Journal of Product Innovation Management*, vol. 23, 2006, pp.19-25.
- [16] K. M., Eisenhardt, and S. L., Brown "Product Development: Past Research, Present Findings, and Future Directions" *The Academy of Management Review*, vol. 20, No. 2, 1995, pp. 343-378.
- [17] K. C., Ding "Developing a Multicriteria Approach for the Measurement of Sustainable Performance." *Building Research & Information*, vol. 33, No. 1, 2005, pp. 3-16. doi:10.1080/0961321042000322618.
- [18] F. Székely, and M. Knirsch, "Responsible Leadership and Corporate Social Responsibility:: Metrics for Sustainable Performance." *European Management Journal*, vol. 23, No. 6, 2005, pp. 628-47. doi:10.1016/j.emj.2005.10.009.
- [19] T., Bieker, "Sustainability Management with the Balanced Scorecard." In *Corporate sustainability : theoretical perspectives and practical approaches*, edited by Ines Oehme, vol. 51, 2005, pp.121-46. München: Profil. <https://www.alexandria.unisg.ch/39738/>.
- [20] S., Tréducq, "Réaliser une cartographie stratégique à partir des indicateurs GRI : Indicateurs et tableaux de bord.", *Édition AFNOR*, 2009, pp. 1-22.
- [21] J. M., Bland, & D. G., Altman, "Statistics notes: Cronbach's alpha.", *Bmj*, vol. 314, No. 7080, 1997, pp. 572.
- [22] L., Guttman, "A basis for analyzing test-retest reliability." *Psychometrika*, vol. 10, No. 4, 1945, pp. 255-282.
- [23] W., Tang & Y., Cui "A Simulation Study for Comparing Three Lower Bounds to Reliability." *Available online at: http://www.crame.ualberta.ca/docs/April_2012/AERA_paper_2012.pdf*, 2012.
- [24] C.A., Cerny, & H.F., Kaiser, "A study of a measure of sampling adequacy for factor-analytic correlation matrices." *Multivariate Behavioral Research*, vol. 12, No. 1, 1977. pp. 43-47.
- [25] M. S., Bartlett, "Properties of sufficiency and statistical tests". *Proceedings of the Royal Statistical Society*, Series A 160, 1937. pp. 268–282 JSTOR:96803.
- [26] R. J. Fox., "Confirmatory factor analysis". *John Wiley & Sons, Ltd*, 1983.
- [27] M. T., Ullman, "The Declarative/procedural Model of Lexicon and Grammar." *Journal of Psycholinguistic Research*, vol. 30, No. 1, 2001, pp. 37-69.
- [28] DW, Kaplan, "Structural Equation Modeling: Foundations and Extensions" *Thousand Oaks, CA: Sage Publications, Inc*, 2000..
- [29] K. J., Klein, F., Dansereau, & R. J., Hall, "Levels issues in theory development, data collection, and analysis" *Academy of Management Review*, vol. 19, 2004, pp.195 – 229.
- [30] L. R. Tucker, and L. Charles, "A Reliability Coefficient for Maximum Likelihood Factor Analysis." *Psychometrika*, vol. 38, No. 1, 1973, pp. 1–10.
- [31] H. Wold, "Partial least squares." *Encyclopedia of statistical sciences*, 1985.
- [32] J. Henseler, C. Ringle and R. Sinkovics, "The use of partial least squares path modeling in international marketing." In *New challenges to international marketing*. Emerald Group Publishing Limited, 2009. pp. 277-319.
- [33] C. M. Ringle,, M. Sarstedt, R. Schlittgen et al. PLS "Path modeling and evolutionary segmentation." *Journal of Business Research*, vol. 66, No. 9, 2013, pp. 1318-1324.

Authors' Profiles



M. Mohamed Amine Marhraoui is a PhD candidate at ENSIAS (National Higher School for Computer Science and System Analysis) Rabat Mohammed V University, Morocco. Within TIME Laboratory (Information Technology and Management), his thesis subject tackles the impact of Information Technology on firm's organizational agility and the mediating role of agility in enhancing enterprise's performance.

M. Marhraoui has graduated from ENSEIRB (Telecommunications, National School of electronics, computer and telecommunications of Bordeaux, France, 2007) and obtained an MSc in Commercial Engineering and Project Management from INSEEC Business School (Paris, France, 2011). M. Marhraoui has worked as a consultant in Information Technology management, organization and project management in different sectors (energy, industry and banking).



PR. Abdellah EL Manouar is Ph. D Economics; He has obtained diploma of a Bachelor in Economics and Law from University Mohammed V (Rabat, Morocco, 1980), a Master of Economics (Money, Finance and Banking, University of Clermont-Ferrand, France, 1981), a M. Sc. Economics (Money and Macroeconomic policy, Department of Economics, University of Montréal, Canada 1983) and a Ph. D Economics (Macroeconomic and international finance, Department of Economics, University of Montréal, Canada, 1990). He is now a Professor at ENSIAS (University Mohammed V, Rabat, Morocco) where he is teaching courses in economics, finance and electronic management. He accumulated a long teaching experience (almost 30 years) in different institutions (Morocco, Canada and France). PR A. EL Manouar's research interest covers new economy and ITC economics (Information Economy, digital economy and E-business) and Classical economics (Industrial economy, Macroeconomics and Monetary Theory, Corporate Finance, Economic Relations and International Finance).

How to cite this paper: Mohamed Amine Marhraoui, Abdellah El Manouar, "IT Innovation and Firm's Sustainable Performance: The Intermediary Role of Organizational Agility – An Empirical Study", *International Journal of Information Engineering and Electronic Business(IJIEEB)*, Vol.10, No.3, pp. 1-7, 2018. DOI: 10.5815/ijieeb.2018.03.01