

Analysing Impact of Internet of Things (IOT) on Sports

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Article Info

Volume 83

Page Number: 3164 - 3175

Publication Issue:

March - April 2020

Article History

Article Received: 24 July 2019

Revised: 12 September 2019

Accepted: 15 February 2020

Publication: 21 March 2020

Abstract:

The technology of the Internet of Things (IoT) aims to identify the physical objects around us. The factors that the providers of this technology must take into account to attract users. Convince them of the added value of these objects and to moderate fears related to the confidentiality and security of personal data. However, the current literature still lacks studies specifically for this type of technology. In this article, we study the determinants of the intention to use the internet of things for the sport. The results of the study showed a strong impact of social influence on the perceived utility, perceived control and perceived credibility of the provider as determinants of the intention to use connected things for the sport. Besides, perceived control and perceived utility had an impact on the perceived credibility of the provider. This integrated model provides further explanation of the user's intentional behaviour regarding the use of the Internet of Things for Sport.

I. INTRODUCTION

In the last decade, the Internet of Things has penetrated silently our daily lives, thanks to the strong growth of communication technologies such as internet infrastructure (Wifi, 4G) and RFID chips which are the basis for the success of these connected objects (Atzori, Luigi 2010, Zanella A, Bui N, Castellani A, Vangelista L, Zorzi M(2014)., Han S, Khan I, Lee G, Crespi N, Glitho R (2016).

Currently, IoT technology encompasses several services and standards and is even considered as the basis for the future ICT market (Bell C, 2009).

In practice, this technology is the result of an interaction between two or more connected devices and intelligent instantly interact to achieve a shared goal. The architecture of this combination differs according to objectives, features and targets. Today, connected objects have become integrated into all types of sport. They are found in tennis, swimming, football and athletics, in

different forms and for various uses: connected balloons, connected bracelets, connected jerseys, connected socks ... These objects will certainly innovate our sporting habits ...

The analysis and the monitoring of the sports performances remain the major concern of the users. Thanks to new technologies, and especially connected objects, it has become possible to measure sports activity carefully. The same study puts forward the positive impact of the "sportiness" of the person's entourage on his commitment to physical activity and sports. This observation favors our hypothesis of the social influence on the user of connected objects for sport.

Theoretical Frame

A. Social Influence

When analyzing the behavior of individuals in the face of new technologies, we cannot neglect the social aspect and its important influence on choice

and confidence in new technologies. Social influence refers to the fact that individuals' behavior changes under the influence of others (Sowmya R, Suneetha K.(2017), Wang, Jiang, Wu and Xiong, 2014). The impact of social influence depends on the characteristics of individuals, the relationships between them, the distances of the network and the effect of time (Günther W, Rezazade Mehrizi M, Huysman M, Feldberg F(2017). Lester S(2000). and Madden, Thomas J. 1992, argue that social influence has an impact on the different stages of the decision-making process of purchasing or adopting a new technology, they specify that the individual can decide to perform behavior not only to achieve reward or avoid punishment, but for other reasons. These reasons are related according to Lester S(2000). and Madden, Thomas J. 1992 to the fact that the individual wishes by its realization of a certain behavior to submit to the objectives, and to the orientations of its reference groups (Family, friends, superiors) and to carry out behavior appropriate to the expectations of a social group.

B. Perceived utility

Perceived utility refers to the degree to which the use of technology improves the user's performance and the manner of performance (Van Der Heijden H(2004)). It is the overall perception of performance and benefits that the user plans to achieve through the use of technology, it also depends on the degree of contribution of an application in improving the user's performance. According to Van Der Heijden H(2004)., the term "useful" means "the usability of a product / service profitably and advantageously". This notion of perceived utility has preoccupied many researchers with its major and determining role in user behavior and its significant predictive power Van Der Heijden H(2004). Utility is the context of connected object research, Weiss D, Shanteau J(2003).) argue that the perceived utility of IOTs by users depends on the degree to which this technology can improve their daily lives. According to Devezas, Tessaleno C.Linstone, Harold A.Santos, Humberto J.S. 2005, the perceived utility of

connected objects plays a crucial role in the adoption of this technology in the United States. In addition, Deye Vincent Michel, P., Ehrmann, S., Da Silva, D., Piagnerelli, M., ... Laterre, P.-F. (2016). et al. (2012) argues that perceived utility is a determining factor in the intention to use the Internet of Things in the UK based on this broad discussion of utility perceived by different researchers and in different contexts. It can be summarized that this variable is very important and influences the intention to use connected objects for sport.

C. Perceived control

Users must have the necessary skills to use IoT systems and peripherals. For example, the use of mobile IoT devices to maintain the mechanical condition of trains or monitor the temperature of the wheels by railway personnel who do not master this technology creates control anxiety and even a negative assessment of the technology. IoT.

Perceived control is a crucial element in theories that focus on the adoption of new technologies, it facilitates the engagement of individuals in the research and analysis of relevant information. Other previous studies have shown that perceived control relieves users of concerns about privacy of personal information on social media (Twidale M (2005). Gerlach J, Widjaja T, Buxmann P(2015).

D. Perceived credibility of the manufacturer

Credibility refers to the competence of the source, media, communicator, message, brand and company. It reflects the positive or negative rating made by the user. Credibility is not a manufacturer-specific attribute, but a subjective perception of its image, skill, and reputation formed by users based on acquired information and experiences with it previously (Brooks F(2003)., Van Bruggen J (2005). It reflects the positive / negative evaluation made by the user. The skill of the manufacturer depends on his knowledge, his qualities, his intelligence, his qualifications and his experience. These elements allow him to control and control the situation so that

the exchange is done without any incident. The second major component of credibility is trust in the manufacturer's intent, ethics and integrity. Researchers point out that the characteristics of the source play a very important role, especially when the evaluation and the decision become difficult in the context of a less relevant content, the complicated nature of the data, the low involvement of the user or even that the latter lacks experience (Nduneseokwu C, Qu Y, Appolloni A(2017 and Maheswaran 1994,

E. The intention of use

The intent is a crucial theoretical concept in the theory of user behavior. It can predict future actions of purchase or use of products or services. For Lallmahomed M, Nor N, Ibrahim R, Rahman A(2013), the intention of use is the internal determination to perform a behavior.

. Behavioral intention theory distinguishes the theory of reasoned action from the theory of planned behavior. The theory of reasoned action is based on subjective and attitudinal norms. However, the theory of planned behavior adds the concept of perceived control. The latter takes into account all the resources that determine the performance of the behavior and that can be monetary, ethical or spatio-temporal. Some authors have proved that the theory of planned behavior has enriched the theory of reasoned action (Madden, Thomas J. 1992)

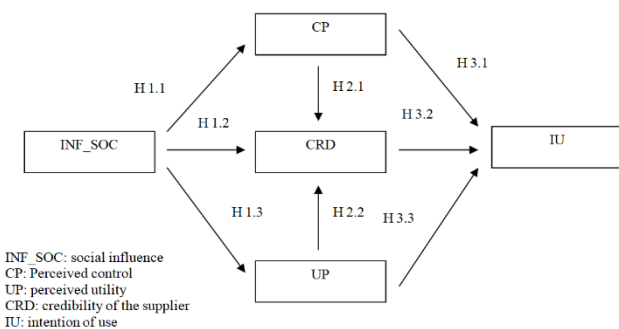


Figure 1: The theoretical model

II. RESEARCH METHODOLOGY

A. Instruments for measuring model variables

The scales of social influence and perceived control we use are those adopted by Faqih K(2013). each measured by three items. With respect to perceived utility, we have adopted the Amoako-Gyampah K, Salam A(2004),and Van Der Heijden H(2004) scale. For the credibility of the supplier, we adapted the measurement scale established by Baranick B, Lemp N, Nagashima J, Hiraoka K, Kasahara N, Logg C(2008). and developed by Okazaki S(2005). this scale is measured by 5 items. Finally, the intention of use was measured by the scale established by Amoako-Gyampah K, Salam A(2004),and Van Der Heijden H(2004). and developed by Benlian A, Koufaris M, Hess T(2011). The validity and reliability of the proposed measuring instruments proved to be robust after the empirical tests carried out in previous studies.

Table 1: The characteristics of the sample of the study

		Nb	(%)
Sex	Men	137	46%
	Women	163	54%
	Total	300	100%
Professional category	Farmers, artisans, traders, entrepreneurs	10	3%
	Frames and prof. intermediaries	149	50%
	Employees, workers	52	17%
	inactive	89	30 %
	Total	300	100%
Age	Under 25	85	28%
	25-39 years	151	50%
	40-54 years	56	19%
	55 years old and over	8	3%
	Total	300	100%

B. Target population and administration of the questionnaire

After choosing the questionnaire for the collection of data, we will determine the mode of administration that can be administered online, face-to-face, by

telephone, or by post (Ferguson R (2008) Regarding the sample, we limited our research on the French population mainly to people who exercise a sporting activity. We shared our social media quiz targeting French sports groups and the answers were collected via Google Forms.

C. STATISTICAL TOOL OF EMPIRICAL ANALYSIS

We have chosen to use the second order structural equation method to analyze our research model which contains latent variables with several dimensions. k are two, the first method is "LISREL (Linear Structural Relationship)" which is based on covariance analysis and maximum likelihood second . Due to the complexity of our theoretical model, we have opted for the PLS method, this choice is justified by several criteria: first, it does not require a large sample, et al. 2014, Hair J, Sarstedt M, Ringle C, Mena J(2012).). The analysis of the measurement model and the structural model (hypothesis testing) is performed on the graphical interface of the SmartPLS 2.0 software using validation techniques.

D. The reliability of the variables of the research model

We verify the reliability of the variables in our research model, by measuring the internal consistency of the constructs, the Cronbach's alpha and the composite reliability (Composite reliability) must have values greater than 0.7 (Bollen K, Noble M(2011)).

Table 2: Results of Model Variable Analysis

Variables	Ladde rs	Lo adi ng	Alp ha Cr onb ach	AV E	Comp osite Reliab ility	RSq uare
Percei ved contr ol (CP)	CP 1	.80 54	0.9 56	.80 29	.9164	0.296 6
	CP 2	.90 36				
	CP 3	0.9 94				
Vend or Credi	CRD 1	0.9 6	.97 85	.81 40	.9400	.2055
	CRD	.93				

bility (CRD)	2	34				
	CRD 3	.97 55				
	CRD 4	.67 82				
	CRD 5	.95 39				
	INF SOC 1	.92 57	.97 46	0.8 95	.9908	
INF SOC 2	.93 82					
INF SOC 3	.85 38					
Percei ved utility (UP)	UP 1	.63 65	.89 48	.71 80	.9086	0.059 9
	UP 2	.96 58				
	UP 3	.97 74				
	UP 4	.83 55				
	UP 5	.78 90				
Inten ded use (IU)	IU 1	.96 73	.90 36	.92 37	.8875	.3399
	IU 2	.94 50				

From the data in the table above, we see the validity of our theoretical model with composite reliability (CR) values that exceed the minimum acceptance threshold of 0.7, this reliability justifies a level of consistency internal high. Regarding Cronbach's alpha values are very satisfactory and above the minimum threshold of 0.7. The data in this table are generated by the SmartPLS software and also allow us to verify the convergent validity of the variables. After an analysis of the results, we find that the convergent validity is confirmed, since all the items represent a correlation threshold higher than 0.7 with a shared mean variance (AVE) greater than 0.5. This indicator allows us to verify in addition to the convergent validity of the variables (Chin 1998), the discriminant validity too (Bollen K, Noble M(2011)).

E. The discriminant validity of the variables

According to Weston, Rebecca (2006) the square root must be greater than the variation between said shared variable and other variables in the model.

We will analyze the discriminant validity by the technique of cross loading variables using SmartPLS. The table below presents the values of the correlation between the variables of our search model and the square root of the AVE represented diagonally.

Table 3. Square root of the eTA and correlations between variables

	CP	CRD	INF_SOC	IU	UP
CP	.8820				
CRD	0.3089	.9372			
INF_SOC	.5444	.2732	.9914		

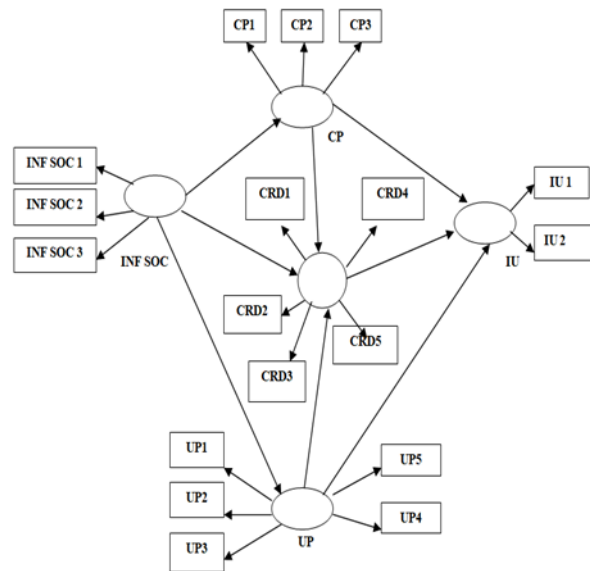


Figure 2. The results of the resampling technique

Table 4. Validation of research hypotheses

Hypotheses	T value	Error	5% risk verification
CP → CRD	3.1906	0.078	Validated
CP → IU	4.560	0.0658	Validated
CRD → IU	4.3728	0.0449	Validated
INF_SOC → CP	9.1377	0.0785	Validated
INF_SOC → CRD	2.8999	0.10	Validated
INF_SOC → UP	2.8358	.1037	Validated
UP → CRD	6.2671	0.08	Validated

H1: Social influence positively influences the perceived control of connected objects for sport

The test shows that there is a valid relationship between social influence and perceived control of connected objects for sport, so hypothesis 1 is validated ($t = 8.9388$, $\beta = 0.0496$). This observation indicates that the opinions of the referents (family and friends), the important people (chief at work ...) or even the leaders favor the perception of the control during the use of the connected objects for the sport.

III. RESULTS OF THE STUDY

A. Analysis of the structural model

The results obtained by the algorithm PLS show that variables of our research model explaining the intention to use objects connected to sports ($R = 32\%$). Depending on the size of our sample, we can say that the value of R^2 meets the minimum threshold of 0.13 determined by Wetzels et al. (2009). This proves that our theoretical model is significant and the results are satisfactory.

B. Validation of theoretical hypotheses

In the present research, we adopt the analysis by resampling techniques (bootstrap) on SmartPLS ($n = 300$, 500 iterations). (Hamdollah R, Baghaei P(2016).

H2: Social influence positively influences the credibility of the supplier of connected objects

The test carried out shows the social influence on the perceived credibility of the supplier of connected objects for sport, hypothesis 2 is therefore validated ($t = 2.5699$, $\beta = 0.06$). This finding indicates that the opinions of the referents (family and friends), the important people (chief at work ...) or even the leaders influence the perception of a credible image of the supplier of the connected objects for the sport.

H3: Social influence positively influences the perceived usefulness of connected objects

The test shows that there is a valid relation between social influence and the perceived usefulness of connected objects for sport, so hypothesis 3 is validated ($t = 3.1353$, $\beta = 0.0637$). This observation indicates that the opinions of referents (family and friends), important people or even leaders influence the perception of the usefulness of connected objects for sport.

H4: Perceived control promotes supplier credibility

The test carried out shows that the perceived control promotes the credibility of the supplier of connected objects for sport, hypothesis 4 is therefore validated ($t = 2.1606$, $\beta = 0.063$). This result indicates that perceived control drives trust in the technology provider and the perception of a credible image.

H5: Perceived control promotes intent to use connected objects

The test results achieved show that perceived control motivates intent to use the objects connected to sports, the hypothesis is validated 5 ($t = 4.3903$; $\beta = 0.0529$). This result indicates that perception of control promotes the intention of using connected objects for sport.

H6: Perceived utility enhances supplier credibility

The results indicate that perceived usefulness is positively significantly related to intent to use connected objects, then the hypothesis is validated 6 ($t = 5.6661$; $\beta = 0.06$). This observation proves that the more the connected object is perceived as useful by the users, the more they perceive a credible image of its supplier.

H7: Perceived utility favors IoT purchase intent

The results indicate that perceived utility is positively related to the intention of use of connected objects, so hypothesis 7 is validated ($t = 8.4856$, $\beta = 0.0522$). This finding proves that the more users perceive the utility of connected objects for the sport, the more the intention to use these objects increases.

H8: Perceived Manufacturer's Credibility Supports Intent to Use IoTs

The statistical test reveals that the perceived credibility of connected objects for sport positively and significantly influences the intent to use objects. Hypothesis 8 is validated ($t = 3.3624$, $\beta = 0.0571$). This result indicates that the greater the credibility of the connected objects provider, the more users will trust these objects and the services they offer, the more they intend to use them.

CI. Social influence on model variables

The results of our study prove the impact of social influence on perceived control, this result suggests that the user's entourage and his referents influence his perception of being able to control the use of connected objects for sport and control its effects with the help of people considered as experts or influencers in the case of social networks. To our knowledge, there is no previous study on this relationship in the context of technological adoption. In addition, the social influence also impacts the perception of the usefulness of connected objects, this observation joins the contributions of some previous research which has already validated this relation as the study of Groom, Victoria 2009. This

result reflects the impact of the environment, referrals, superiors at work, or even online opinions and recommendations on the adoption of technologies. Kareklas I, Muehling D(2014) argue that the user shares the opinions of his referents concerning a technology. In the case of a new technology as in our search with connected objects for sport, users rely on the opinions of reference persons considered as experts to recommend the use of this technology, provide them with information about the pros and cons. The usefulness of technology remains the key to acceptance by users, it helps foster trust in the supplier and mitigates fears related to the use of any new technology, significant investment in research and development permanently are highly recommended to stand out from the competition and launch new features that will make life easier for users.

Influence on the intended use of connected objects for sport and the mediating effect of perceived control and perceived usefulness

Based on the results of our study, we confirm that perceived control influences the intention to use connected objects, this finding is confirmed by many previous studies such as Vermeir, Iris Verbeke, Wim 2006, Truong Y (2009). and is also part of Ajzen, Icek 2010 model of planned behavior as an antecedent of usage intent. Indeed, to intend to use the connected objects for the sport, the users need to feel in control situation, so the suppliers must make efforts of communication in order to put at the disposal of the potential customers all the information related to these objects to reassure them. The results of this study also showed the impact of perceived utility on usage intent, which has also been broadly confirmed in several previous studies, such as the Van Der Heijden H(2004), which considers that perceived utility is an antecedent that strongly and directly influences the intention of use. Deye Vincent Michel, P., Ehrmann, S., Da Silva, D., Piagnerelli, M., ... Laterre, P.-F. (2016). et al. (2012) also argue that perceived utility is a

determinant of the intention to use connected objects. It is therefore necessary that the suppliers of connected objects give more importance to technological innovation to bring to the market connected objects with new useful features that will make life easier for users. Therefore, providers of connected objects must look after a credible image with potential customers to encourage them to adopt this technology. In the case of a new technology, the credibility and expertise of the supplier play a crucial role in the success of the market and the attraction of new customers. Finally, the results of our research prove the existence of a mediating effect of perceived control and perceived utility on the relationship between social influence and intention of use. To examine this mediating effect, the method of Lutz R, Karoly P, Okun M (2008). seems the most adequate, after the execution of the bootstrap technique we start by evaluating the indirect relationship between social influence and intention to use which is significant with a p value of 0.0434 <0.05 (Lutz R, Karoly P, Okun M (2008). Next, we calculate the confidence interval for the relationship between social influence and usage intent with perceived control as mediator and according to the instructions of Lutz R, Karoly P, Okun M (2008). the two limits of the interval are greater than zero, are greater than zero (Lutz R, Karoly P, Okun M (2008), so we confirm that perceived utility plays a mediating role in this relationship.

Table 5. The results of the mediating effect of social influence

INF_SOC →CP	CP→I U	Indire ct Effect	SE	t- value	95% LL	95% UL
0.2097	.5129	0.095 44	0.06 3	1.997	0.00 4	.203 5

TABLE 6. RESULTS OF THE MEDIATING EFFECT OF PERCEIVED CONTROL

INF_SOC→UP	UP→IU	Indirect Effect	SE	t-value	95% LL	95% UL
.5834	.3328	0.11291	0.062	2.3712	0.020	.2079

Managerial Implications

The results of our study provide interesting managerial implications for companies specializing in the field of connected objects. On the one hand, it is important for managers to give great importance to social influence. Indeed, as our results prove, social influence is a crucial variable that strongly impacts the decisions of users especially in a context of new technologies where the data exchanged are sensitive (personal data, geographical location, etc.). In addition, connected objects are a recent technology that is not yet well known by users, they may have erroneous information about these connected objects. For this, companies must work to win the trust of the user, to motivate him to recommend this technology. Suppliers of this technology must be always close to the market, react in real time with users in all communication channels (social networks, website, forums, etc.), share useful information about these connected objects, collaborate with influencers on social networks to promote technology, create a climate of trust with users and improve the utility of these connected objects. On the other hand, the connected object providers must invest in the RetD in the domain of user behavior in order to better understand the target of this technology, its expectations and its inspirations. Suppliers of this technology must be always close to the market, react in real time with users in all communication channels (social networks, website, forums, etc.), share useful information about these connected objects, collaborate with influencers on social networks to promote technology, create a climate of trust with users and improve the utility of these connected objects. On the other hand, the connected object providers must invest in the RetD in the domain of user behavior in order to better understand the target of this technology, its expectations and its inspirations. Suppliers of this technology must be always close to the market, react in real time with users in all communication channels (social networks, website, forums, etc.),

share useful information about these connected objects, collaborate with influencers on social networks to promote technology, create a climate of trust with users and improve the utility of these connected objects. Finally, the intention to use is a determining factor in the decision to buy and use new technologies and connected objects for sport as part of our study, hence the need for companies to take in consideration the recommendations and results of the present study in order to successfully establish a climate of trust towards users and convince them to use connected objects for sport. Another point consists in exploiting the data collected as and when connected objects to develop and adapt the proposed offer. Thus, depending on the behavior of the user, the provider can offer a personalized and unique service which presents a great added value for the users.

IV. LIMITATIONS AND PERSPECTIVES OF RESEARCH

The present research is an exploratory study that aims to study the impact of certain factors of technological acceptance on the intention of using connected objects for sport. This research is not without limits. We have mobilized only a few factors that influence the intention to use connected objects for sport in a sample that has different sociodemographic categories and is not representative. However, the intention of use may be manifested in some segments of users more than others, something we cannot analyze with our sample. For this, it seems necessary to enrich the model by integrating other determining factors, to test the model with a representative sample that will allow to analyze the intensity of the relations between the different segments of the users. It would also be interesting to analyze the validity of this model in a different cultural context.

V. CONCLUSION

Social influence is an important factor in explaining users' intent to use new technologies. Several studies and research have focused on the

adoption of new technologies. In this study, we analyzed social influence and its impact on three determinants of the intention to use connected objects for sport. Our research helps to better understand the role of social influence in the process of adoption of new technologies and specifically objects connected to sports, the impact of perceived control, perceived usefulness of connected objects and perceived credibility of the supplier on the intent to use this technology. In addition, define the elements to be taken into consideration when marketing connected objects for sport and which determine the success or failure of this technology on the market. It is about emphasizing the role of the entourage to motivate the intention of use, so companies must give importance to control the image conveyed, to offer useful features to incite users to adopt the technology and recommend it.

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