

Diffusion of Innovation: An Investigation of e-Procurement Assimilation in the Australian Public Sector

Kishor Vaidya (PhD Candidate)

kishor@turing.une.edu.au

School of Mathematics, Statistics and Computer Science, University of New England,
Armidale, NSW 2351, Australia

Abstract: As part of a larger research project whose objective was to determine the antecedent condition for e-Procurement assimilation, this paper assesses the diffusion of e-Procurement in the Australian public sector. With the help of an extensive literature review and pilot study, e-Procurement diffusion attributes were identified, a research model was developed and hypotheses were formulated. Based on the Diffusion of Innovation theory, it is hypothesized that perceived benefits and compatibility impact positively whereas the perceived complexities negatively impact the transactional and strategic assimilation of e-Procurement. A nationwide web-based survey of Procurement/e-Procurement professionals in the Australian public sector is in the final stage of completion at the time of writing of this paper and analysis of the complete set of data will be presented in the camera-ready version of the paper.

Keywords: Electronic Procurement, Diffusion, Assimilation, Procurement

I. Introduction

Procurement innovation such as Electronic procurement (e-Procurement) is breaking new ground within the public sector of the advanced as well emerging economies by providing the governments with a wealth of supply chain information via the Internet. E-procurement has been on the political agenda in a number of countries [15]. As such, the past few years have seen the greater popularity of e-Procurement technologies in that the governments in the advanced economies including Australia, the USA, and the UK as well as the governments in the emerging economies including China, India, the Philippines, Mexico, Brazil, and Korea are implementing e-Procurement initiatives as part of their Electronic Government (e-Government) agenda. However, just implementing an e-Procurement system is no guarantee to improved procurement performance. It is important that the contextual interrelations between the organisation and management, practices and processes and systems and technology be examined, understood and documented before deciding that e-Procurement might improve procurement performance [29]. The authors advocate such hybrid model for studying e-Procurement implementation processes, particularly for understanding the

implementation events that occur and the antecedent conditions that promote or inhibit implementation outcomes.

The potential benefits of an e-Procurement system commonly include more effective inventory control, reduced purchasing agent overhead, reduced lead times, and competitive pricing [32]. Despite the potential benefits, organizations differ in the speed with which they assimilate e-Procurement and in the level of actual benefits achieved among the organizations that have implemented. The popularity of e-Procurement, at the same time, has raised several research questions that deserve answering in relation to its assimilation. What are the antecedent conditions that could lead towards diffusion of e-Procurement? Which theory can best explain the prevalence of such condition? What would be the impact of such conditions on transactional and strategic assimilation of e-Procurement? This paper attempts to address these questions. As such, following the definition and scope of e-Procurement, this paper conceptualizes the dependent variable for this study – the intensity of organizational assimilation of e-Procurement in the third section. The theoretical support for this study has been provided by the Diffusion of Innovation theory, which has been discussed in the fourth section. The fifth section presents the research model and hypotheses and the sixth section discusses the research methodology adopted. Following the results of the data analysis in the seventh section, this paper concludes with the discussion of limitations of this research and its implications to academics and practitioner in the eighth section.

II. E-Procurement Assimilation: A Literature Review and Development of Hypotheses

This paper regards e-Procurement as the innovation in procurement, as part of e-Government, defined as internet-based applications between two or more companies. An important innovation attribute is the degree to which an innovation creates changes in the structure and functioning of the organization, which requires aggressive technological policy [30]. Damanpour [5] terms this sort of innovation as the “radical” innovation and argues that radical innovations produce fundamental changes in the activities of an organization while routine innovations result in little departure from existing practices. It is important to note that e-procurement is not only the example of radical innovation but also the process innovation. This is emphasized by Sheng, [26], in [5]) that e-Procurement should not only be considered as the re-engineering of old

manual processes but as the re-engineering of the process itself.

The extant literature on technological innovations and electronic commerce has contributed significantly to our understanding of e-Procurement assimilation. However, this literature has limited applicability for investigating the extent of organizational assimilation in the public sector. This is because the technological and transactional characteristics of the Internet differ significantly from other technologies (e.g. EDI) examined in the prior literature. E-procurement assimilation within the same public sector agency may differ between the two phases of assimilation, i.e., e-Procurement use may be high in transactional phase but not in strategic phase, or vice-versa. Furthermore, e-Procurement use may vary extensively across organizations. A comprehensive investigation of this widespread variation necessitates that we conceptualize and examine the organizational assimilation of e-Procurement in both transactional and strategic phases.

Given the definition and scope of e-Procurement in the above section, the intensity of e-Procurement assimilation can be further defined as the degree of adoption, implementation and utilization of e-Procurement technologies across the transactional and strategic procurement process. Although the literature gives account of the various steps or stages in the procurement process, this paper will use the nine important steps of the procurement process namely information search, requisition request, approval, purchase order, delivery receiving (tracking) and payment, and identifying sourcing opportunities, negotiate, and contract [12]. As e-Procurement comes in various forms, assessing the intensity of e-Procurement can help identify what the public sector agencies are doing with e-Procurement, what steps of the procurement process have been automated with e-Procurement technologies and how intensively each step of the purchasing process has been "e-enabled". Furthermore, it is important to various e-Procurement adoption practices as public sector agencies may have different emphases for different steps of the procurement process that need to be automated with e-Procurement technologies. By differentiating the intensity of e-Procurement assimilation across the procurement process, it can be possible to link each domain of assimilation with its resulting dimension of procurement performance. This sort of approach can help the procurement organisation to better assess the impact of antecedent conditions that influence e-Procurement assimilation on the procurement performance.

The intensity of e-Procurement assimilation is the main dependent variable that is the aggregate measure of e-Procurement technologies implemented in the organisation for the conduct of procurement and the assimilation stages. This research has considered a number of technologies utilized including e-Procurement system (third party or in-house), electronic catalogues, electronic marketplace, electronic auction/reverse auction and, electronic tendering. The intensity of e-Procurement assimilation also captures

the concept of assimilation stage [8] for each e-Procurement technology. Furthermore, the intensity of e-Procurement assimilation also quantifies the penetration of each of the e-Procurement technologies to determine the level of support for the transactional and strategic procurement functions. It is important to aggregate these measures to determine the intensity of e-Procurement assimilation in terms of the number of e-Procurement technologies, the extent of their usage and their support for each transactional and strategic procurement activities of the organisation.

The assimilation process that includes adoption, implementation and routinization [19], [22] has been modeled as containing the six stages: i) Intention to implement; ii) Evaluation or Pilot use; iii) Commitment iv); Limited deployment; v) Generalized deployment [8]; and vi) Rejection [23]. The sixth stage can be justified by the authors' arguments that the implementation of an innovation can not be considered successful even if it survives through the deployment stage, as the innovation may ultimately be rejected by its users [23]. Together, these three dimensions provide an e-Procurement intensity index that signifies how many e-Procurement technologies are being used in an organization, to what extent these technologies are being used, and in which stage of the procurement process. In particular, a thorough understanding of e-Procurement assimilation necessitates that the assimilation be examined in both transactional and strategic activities, but the prior literature largely ignores strategic activities and does not examine several transactional aspects (e.g., delivery receiving). The transactional procurement activities included information search, requisition request, approval, purchase order, delivery receiving (tracking) and payment whereas the strategic procurement activities included identifying sourcing opportunities, negotiate, and contract [12].

An aggregate strategy has been chosen to represent these three dimension in order for the findings to be more robust and generalizable [9]. The following six conditions as identified by Fichman [9] that favor aggregation of technologies in the context of this paper are: i) our main interest is to develop a model that generalizes to the e-Procurement class, as opposed to a specific e-Procurement technology such as e-Marketplace; ii) antecedents are posited to have an effects in the same direction in the assimilation stages of a number of e-Procurement technologies ; iii) characteristics of organizations can be treated as constant across the e-Procurement initiatives within the Australian public sector; iv) e-Procurement characteristics cannot be treated as constant across the Australian public sector agencies; v) the innovation in this study (i.e., e-Procurement) can include substitutes or moderate complements and; vi) sources of noise in the measurement of the procurement performance because of e-Procurement may be present.

II. 1 Diffusion of Innovation

A substantial literature exists that investigates Inter-organizational information systems (IOS), and IT adoption,

diffusion and use (e.g., [1]; [13]; [21]; [14]; [10]). As discussed above, the assimilation of e-Procurement initiative can be an issue of technology diffusion and adoption of innovation. Obviously, innovation diffusion theory [24, 25] can be used to understand e-Procurement assimilation as the theory has also been extensively used recently as a fundamental theoretical base of innovation adoption research in the field of IS/IOS. As the adoption of e-Procurement as an innovation generates uncertainty, the procurement organization must be aware of the relative advantage and risk of implementing such innovation. Although the attributes suggested by IDT include relative advantage, compatibility, complexity, trialability, and observability [24, 25], only two variables – relative advantage (i.e. degree to which an innovation is perceived as being better than the idea it supersedes) and compatibility (of an innovation with existing practices and values) have been consistently found to be positively related and only variable – complexity (i.e. degree to which an innovation is perceived as relatively difficult to understand and use) has been consistently found to be negatively related to adoption of innovation [28]. As the different public sector agencies with different adoption intensity can perceive the characteristics of an innovation differently, Downs and Mohr [7] suggest taking perception-based characteristics of innovation into account rather than the inherent characteristics of the technology that do not vary across settings and organizations. Figure 1 below presents the research model.

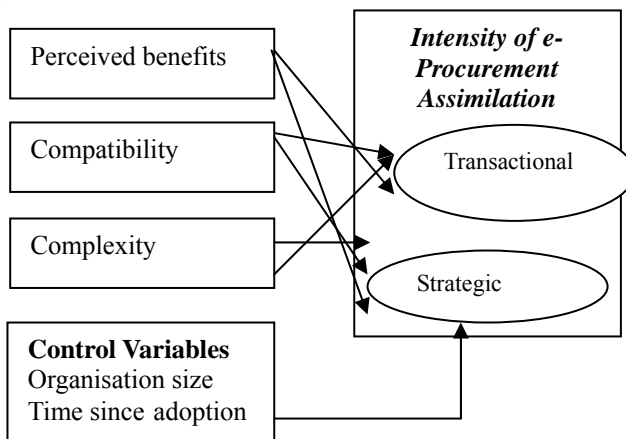


Figure 1: The Research Model

II. 2 Perceived Benefits

Perceived benefits refer to the anticipated advantages that an innovation can provide to the organisation. A number of studies have found that perceived benefits significantly impact IT adoption (e.g., [5], [2], [21], [16]). As organizations are motivated by the perceived benefits from the adoption of an innovation [16], they realize the need to use the technology fully and integrate it with existing applications [21]. Once the organizations are convinced of the relative advantages, they tend to allocate the managerial, financial and technological resources necessary for adoption

[2]. The availability of the necessary resources including the technical infrastructure also facilitates higher technical knowledge, which in turn increases the use of assimilation [5].

Relative advantage is apparent in the form of increased efficiency [24]. While Kalling and Cadeerskold [18] argue that e-procurement does not replace an existing system (but is rather a complement to existing ones, i.e. binary), the practitioner literature has reported the relative advantage of e-Procurement in various contexts. For example, according to the recent e-Procurement Benchmark report by the Aberdeen Group [20], organizations have been able to reduce off-contract spending by 64%, requisition-to-order cycles by 66% and requisition-to-order costs by 58%. The use of the Internet, the open standard, and the web technologies are such strengths of e-Procurement technology that contribute to interoperability. Interoperability promotes integration, however, also poses risk and security threats when organizations integrate e-Procurement systems with other internal information systems. Hence it can be hypothesized that:

H1a: Greater the extent of benefits of e-Procurement, greater will be the intensity of its transactional assimilation in the organization.

H1b: Greater the extent of benefits of e-Procurement, greater will be the intensity of its strategic assimilation in the organization.

II. 3 Compatibility

Compatibility of an innovation can be thought of as the organizational fit of the system introduced [19]. It is the degree to which the innovation is perceived as being consistent with existing financial and accounting systems, procurement practices and the e-Procurement implementation strategy and procurement policies and guidelines of the organization. This approach provides us with an opportunity to identify the different types of compatibility – technological and organizational. E-Procurement might require changes in the existing stages of the procurement processes and practices and might introduce new or reduced stages to complete the purchase-to-pay cycle. According to Premkumar and Ramamurthy [21], compatibility of the new system with existing work procedures increases the likelihood of adoption and this is also true in the case of e-Procurement. Hence it can be hypothesized that:

H2a: Greater the extent of compatibility of e-Procurement, greater will be the intensity of its transactional assimilation in the organization.

H2b: Greater the extent of compatibility of e-Procurement, greater will be the intensity of its strategic assimilation in the organization.

II. 4 Perceived Complexity

Rogers [25] has defined perceived complexity as the degree to which an innovation is perceived as relatively complex to

understand and use. As the assimilation of e-Procurement as an innovation generates uncertainty, the procurement organization must be aware of the relative advantage as well as the risk of implementing such innovation. As the assimilation progresses, Teo et al. [27] note that the heightened knowledge gap between the current requirements and the current resources creates a higher sense of uncertainty about the innovation for the organization. Based on Zaltman et al.'s [31] classification, two levels of complexity can be identified. First e-Procurement implementation may contain complex ideas, i.e., e-Procurement may be difficult to understand from a business as well as technical perspectives. Second, using e-Procurement may be difficult to understand and visualize the whole process of procurement-to-pay (P2P). It is also important to note that ease of use is an important indicator of information systems success [6]. Hence it can be hypothesized that:

H3a: Greater the extent of perceived complexity of e-Procurement, lower will be the intensity of its transactional assimilation in the organization.

H3b: Greater the extent of perceived complexity of e-Procurement, lower will be the intensity of its strategic assimilation in the organization.

III. Research Methodology

Initial feedback on the survey instrument was sought from ten academic experts at the Australian, UK and US universities. The initial structured questionnaire was generated based on the pilot study with Procurement/e-Procurement managers involved in the implementation of e-Procurement, and academic and practitioner-oriented (government reports) literature. A total of 40 professionals from the five states of Australia including the agencies that are actively involved in the implementation of e-Procurement such as Centrelink, Australian Government Information and Management Office, Standards Australia, SmartBuy (NSW), Australian Antarctic Division (AAD), CSIRO etc. participated in the study. The comments were sought on the length, completeness and readability of the survey and each item was reviewed for content, scope and purpose. Results of the pilot study were used to assess the content validity of the measures. Although the participants indicated no major modifications with regards to the conceptual model and the antecedent conditions for e-Procurement assimilation, however, a number of important comments were incorporated in the instrument development and wording/consistency of the questionnaire items.

A five-point Likert scale was used to collect the response. The preliminary version of the questionnaire was pre-tested during the qualitative pilot study (email communication, informal interviews). Iterative refinements were made to the preliminary version and the final version of the questionnaire consisted of nine items for the two constructs. Since the time period was still early in the early stages of e-Procurement in organizations, the public sector agencies

were chosen opportunistically – that is, the researcher sought the agencies that have implemented or were beginning to implement e-Procurement, rather than to seek a representative set firms who were both adopters and non-adopters of the technology.

Respondents were asked to indicate the extent of their organisation's level of e-Procurement use in terms of overall procurement transaction on the scale of "No intention to implement", "Intention to implement", "Evaluation or Pilot use", "Commitment", "Limited deployment", "Generalised deployment" and "Rejection". Respondents were also asked to indicate the predominant e-Procurement technology among the e-Procurement technologies through which their organisation uses (or plans to use) to conduct procurement in terms of overall procurement transactions. In order to assess whether the e-Procurement assimilation was transactional or strategic, respondents were asked to indicate the procurement activities that are supported by e-Procurement in their organizations. The transactional procurement activities included information search, requisition request, approval, purchase order, delivery receiving (tracking) and payment whereas the strategic procurement activities included identifying sourcing opportunities, negotiate, and contract [12]. Control variables included the size of the organisation - measured in terms of organisation's annual direct and indirect procurement expenditure for the last financial year, and assimilation gap which was measured by asking the respondents when their organizations first adopted e-Procurement.

Overall navigation of the survey website was designed to be linear, as simplified as possible. Respondents were required to indicate the name of their organizations or divisions/units. Following the suggestions of Couper et al. [4] to avoid checkboxes in academic web-based research, radio buttons were used instead. A federal government agency, the Australian Procurement and Construction Council (APCC) agreed to endorse and administer the survey, which is supposed to generate a greater response rate. Also, as with any survey research, response bias is always a concern, however, given the arrangements in regards to the administration of the survey, it can be anticipated that misleading responses will not be submitted by the professionals of the government agencies (members) who are usually aware of the accountability and ethical issues.

IV. Data Analysis and Results

Given the cross-sectional nature of this research, correlation and regression analyses [3] will be completed using the statistical software package SPSS 13. While the correlational analyses will be used to support (or reject) the hypotheses, consistency will be ensured by taking into account the regression analyses that regression results can categorically reject such support. Furthermore, testing the measurement model will involve examining the internal consistency (Cronbach's α), convergent validity (factor loading), and discriminant validity (correlations) of the constructs. It has

not been possible present the analysis of complete set of data as only 70 responses have been received at the time of writing of this paper, however, we will come up with the results of this research when submitting the camera-ready version of the paper.

V. Conclusions

This paper has both academic and practitioner implications. Academically, this paper has proposed an e-Procurement assimilation model which draws its insights from both the literature on diffusion of innovation adoption as well as from e-Procurement research on organizational assimilation. Such a model can be hoped to explain the interplay among organizational context variables, attributes of managers' implementation strategies, and other characteristics that, in aggregate, shape assimilation process and outcomes of e-Procurement initiatives in the public sector. By developing a clearer connection between existing theory and apparent most relevant factors, a richer, more generalizable understanding of the antecedent conditions influencing the e-Procurement assimilation and its impact on the procurement performance is likely to emerge. By dividing procurement activities into transactional and strategic phases, we are able to distinguish the impacts of antecedent factors on different phases. Such an approach also enables us to evaluate if the same e-Procurement antecedents impact procurement performance in the organizations differently in the two phases. From the practitioner point of view, since the phenomenon under investigation is still in early stages, our research has considerable practical implications for procurement professionals and e-Procurement project managers. This study presents the critical antecedent conditions that influence the extent of e-Procurement assimilation. It can be expected that the procurement professionals and e-Procurement project managers in the public sector can influence and manage the e-Procurement assimilation in light of these antecedent conditions.

While the Diffusion of Innovation Theory is still relevant for the study of e-Procurement adoption and implementation, Gallivan [11] suggests that these theories only focus on the individual level adoption of innovation and neglect the realities of implementing technologies in the organizational level. Similarly, Jenkins-Smith & Sabatier [17] maintain that stage models operate without a causal motor, i.e. they lack identifiable forces that drive the policy process from one stage to another. Given these limitations, it is necessary to study the subject of e-Procurement assimilation and our future research in this regard will be focused on using other theoretical bases such as institutional theory and resource-based theory in order to identify further antecedent conditions that may influence e-Procurement assimilation. Another limitation is that this study represents a "snapshot" view of this phenomenon. A longitudinal study would provide more insight. Also, expanding the study

to other industries would provide a more generalizable and robust examination of the hypotheses.

References

- [1] Benbasat, I., Bergeron, M., and Dexter, A. S. 1993. "Development and Adoption of Electronic Data Interchange Systems: A Case Study of the Liquor Distribution Branch of British Columbia", Proceedings of Administrative Sciences Association of Canada Twenty First Annual Conference, Lake Louise, Alberta, Canada, May.
- [2] Cohen, J., Cohen, P., West, S.G., & Aiken, L.S. 2003. Applied multiple regression/correlation analysis for the behavioral sciences (3rd ed.). Hillsdale, N.J.: L. Erlbaum Associates.
- [3] Couper, M.P., Traugott, M.W., & Lamias, M.J. (2001). Web Survey Design and Administration. *Public Opinion Quarterly*, 65(2), 230-253.
- [4] Croom, S., Brandon-Jones, A. 2003. E-service: enhancing internal customer service through e-procurement. *International Journal of Service Industry Management*. Vol. 14 No. 5, pp. 539-555.
- [5] Damanpour, F. 1991. Organizational Innovation: A Meta-Analysis of Effects of Determinants and Moderators", *Academy of Management Journal* Vol. 34, No. 3, pp. 555-590.
- [6] DeLone W.H. & McLean E.R. 2004. Measuring e-Commerce Success: Applying the DeLone & McLean Information Systems Success Model. *International Journal of Electronic Commerce*. Vol. 9, No. 1.
- [7] Downs, G. W., and Mohr, L. B., 1976. "Conceptual Issues in the Study of Innovation," *Administration Science Quarterly*, Vol. 21 pp. 700-714.
- [8] Fichman, R. G., & Kemerer, C. F. (1997). The Assimilation of Software Process Innovations: an Organizational Learning Perspective. *Management Science*, 43(10), 1345-1363.
- [9] Fichman, R. G., & Kemerer, C. F. (2001). Incentive Compatibility and Systematic Software Reuse. *Journal of Systems and Software*, 57(1), 45-60.
- [10] Fichman, R.G., and Kemerer, C.F. 1999. "The Illusory Diffusion of Innovations: An Examination of Assimilation Gaps," *Information Systems Research*, Vol. 10. No. 3, pp. 255-275
- [11] Gallivan M.J. 2001. "Organizational Adoption and Assimilation of Complex Technological Innovations: Development and Application of a New Framework", *Database for Advances in Information Systems*; Summer 2001; 32, 3 p.51.
- [12] Gebauer J. and Segev A. 2001. Changing Shapes of Supply Chains – How the Internet Could Lead to a More Integrated Procurement Function. Fisher Centre Working Paper 01-WP-1041, University of California.
- [13] Grover, V. 1993. "An Empirically Derived Model for the Adoption of Customer-Based Interorganizational Systems," *Decision Sciences*, Vol. 24, No. 3. pp. 603-640.
- [14] Hart P, and Saunders C., "Power and trust: Critical factors in the adoption and use of electronic data interchange", *Organization Science*, Vol. 8, No. 1, 1997, pp. 23–42.
- [15] Henriksen H.Z. and Andersen K.V., 2003. *E-Procurement Adoption: Theory and Practice*, in EGOV (Ed. R. Traunmuller). LNCS 2739, pp. 121-124. Springer-Verlag Berlin
- [16] Iacovou, C., Benbasat, I. Dexter A. 1995. EDI and Small Organizations : "Adoption and Impact of Technology", *MIS Quarterly*, December, pp. 465-485.
- [17] Jenkins-Smith H.C. & Sabatier P.A. 1993. 'The Study of Public Policy Processes', in Paul A. Sabatier & Hank C. Jenkins-Smith (eds.): 1-9.
- [18] Kalling, T. & Cederskold C. 2004? Technology Implementation: A Qualitative Case Study of E-Procurement, IRIS27 (Information Systems Research in Scandinavia)]
- [19] Kwon, T. H., & Zmud, R. W. (1987). Unifying the fragmented models of information systems implementation. J. R. Boland, & R. A. Hirschheim (Eds.), *Critical issues in information systems research* (pp. 227-251). New York: John Wiley.
- [20] Minhan T. 2005. The E-Procurement Benchmark Report: Less Hype, More Results, Aberdeen Group.
- [21] Premkumar, G., & Ramamurthy, K. 1995. The role of interorganizational and organizational factors on the decision mode for adoption on interorganizational systems. *Decision Science*, 26, 303-336.

- [22] Prescott, M. B., & Conger, S. A. (1995). Information Technology Innovations - a Classification by IT Locus of Impact and Research Approach. *Data Base for Advances in Information Systems*, 26(2-3), 20-41.
- [23] Ramiller, N.C., and Swanson E.B. 2003. Whether, When, and How to Innovate with Information Technology: What do Empirical Studies Tell Us? Information Systems Working Paper 2-03, The Anderson School at UCLA, March.
- [24] Rogers, E. M. 1983. *Diffusion of Innovations*, Free Press, New York.
- [25] Rogers, E. M. 1995. *Diffusion of Innovations*, Free Press, New York.
- [26] Sheng, M.L. 2002. "The impact of Internet-based technologies on the procurement strategy", in *Proceedings of the 2nd International Conference on Electronic Commerce*, Taipei, December.
- [27] Teo H.H., Wei K.K., and Benbasat I. 2003. Predicting Intention to Adopt Interorganizational Linkages: An Institutional Perspective. *MIS Quarterly*, Vol. 27 No. 1, pp.19-49.
- [28] Tornatzky, L. G., and Klein, K. 1982. "Innovation Characteristics and Innovation Implementation: A Meta-Analysis of Findings", *IEEE Transactions on Engineering Management*, Vol. 29, No. 1, pp. 28-45.
- [29] Vaidya K., Sajeev A.S.M., Callender, G. 2004a. *e-Procurement Initiatives in the Public Sector: An Investigation into the Critical Success Factors*, 13th Annual International Purchasing & Supply Education & Research Association (IPSERA) Conference, April 4-7, Catania, Italy.
- [30] Wagemans M. 2001. Political Parties and Innovation: Critical Insights. ECPR 29th Joint Sessions of Workshops, London
- [31] Zaltman, G., Duncan, R. and Holbek, J. 1973. *Innovations and Organizations*, John Wiley & Sons, NY.
- [32] Johnson, P. Fraser, and Robert D. Klassen, 2005. "E-Procurement," *MIT Sloan Management Review*. V. 46, n. 2, Winter, pp. 7-11.