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Madhavi Latha Nandi
Xavier Institute of Management, madhavinandi@yahoo.co.in

Gopal Krishna Nayak
Xavier Institute of Management, gopal@ximb.ac.in

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Madhavi Latha Nandi
      Xavier Institute of Management,
      Xavier Square, Bhubaneswar 751013, Orissa, India
      madhavinandi@gmail.com

Gopal Krishna Nayak
      Xavier Institute of Management,
      Xavier Square, Bhubaneswar 751013, Orissa, India
      gopal@ximb.ac.in

Abstract

With organizations increasingly opting to implement ERP system packages, there is an increasing need to understand what factors facilitate or inhibit the implementation process. In doing so, the paper views the implementation from user-based innovation process perspective and develops models to predict the influence of various organizational factors on the effort associated with various stages of the innovation process. The organizational factors being considered for the study include structural factors that is, centralization, formalization, and specialization, and contextual factors that is, organizational absorptive capacity and organizational publicness.

Keywords: ERP system implementation, Public sector, Innovation process, Absorptive capacity, Organizational factors

1   INTRODUCTION

An ERP system is a packaged business software system that enables an organization to manage the resources effectively and efficiently by integrating various functions of the enterprise. Using ERP systems, the information required for the various business processes that run across the functions is made accessible in a real-time environment (Nah et al., 2001). ERP systems enable enterprises to quickly react to competitive pressures, realize market opportunities, reduce inventory, and tighten supply chain links (Bingi et al., 1999). ERP systems were initially adopted by large organizations mainly, in the developed nations. However, with the saturation of the market of the large enterprises, and significant lowering of the implementation costs, the software providers are now attempting to penetrate into small to middle enterprise (SME) segment and other countries (Bernroider et al., 2001). Moreover, with a large portion of private sector organizations having already implemented ERP systems, the ERP software vendors are shifting their focus to the public sector organizations. Indian market is one such market targeted by the leading ERP system providers.

Majority of the organizations implementing ERP systems, adopt the application packages available in the market and attempt to configure the package to their organizational requirements. Generally, these application packages are designed and developed based on the "best business practices" (Davenport, 1998). ERP system implementations generally, involve massive organizational changes resulting from shifting of existing business processes to those implicit with the ERP systems that represent the best practices (Bingi et al., 1999, Davenport, 1998). ERP system implementations, thus, carry a huge risk of implementation failure in terms of time and costs of the implementation projects as well as post-implementation failure in terms of inadequate use of the ERP system. Many such cases of failure are being documented both in the academic and practitioner literature.

A large number of studies exist that focus on the factors that are most related to the ERP systems implementation success or failure (Esteves et al., 2001). However, prominent gaps still exist. Some of the prominent gaps that are being observed are:

- Though the studies in the factors stream have successfully identified the important factors influencing the implementation process, they do not indicate to what extent, the identified factors explain the success or failure of the implementation of an ERP system.
- Structural, contextual and environmental factors that tend to influence the implementation process of an ERP system remain ignored in the academic literature. The professional methods that are used by the commercial firms seem to focus on the technical factors that contribute to the expenses. The organizational factors that influence the ERP deployment initiatives are generally ignored.
- The temporal dimension that is, what factors are important at what stage, is not acknowledged in many of the studies.
- Overall, very little guidance is available for organizations embarking on to the implementation of ERP systems. There is a need for an empirically verified model that can offer some guidance for the same.

In view of the literature gaps mentioned above, the present research study aims to develop a model, which can predict the effort, associated with various stages of the implementation process of ERP systems. In doing so, the study focuses on the organizational factors which include structural factors such as

centralization, formalization and specialization and contextual factors such as organizational absorptive capacity and organizational publicness, which are likely to influence to the implementation process considerably, apart from the factors specific to the implementation project such as number of modules implemented, number of users and numbers of units getting integrated. The study draws from various strands of literature such as innovation, organizational learning, information systems (IS) implementation and public administration to derive the hypotheses. Section 2 includes the theoretical foundations for the concepts and some of the hypotheses that would be used in the study. Research models and intended approach for data analysis are discussed in section 3 followed by expected contributions of the study for the academia and practice. Expected limitations of the study are discussed in section 5 followed by the references.

2 THEORETICAL FOUNDATIONS

2.1 User-based innovation process

Some of the IS researchers have suggested that the innovation perspective can serve as a basis to understand the process of IS implementation (Lucas et al., 2007; Zmud et al., 1987). From an innovation perspective, ERP systems can be studied using two approaches namely *source-based* and *user-based* approaches. The source-based approach focuses on various phenomena associated with the evolution of the ERP packages. The user-based approach focuses on how the ERP systems are put to use in the target groups (Klein et al., 1991). Literature on various issues associated with user-based innovation process indicates that the user-based innovation process can be broadly divided into three phases namely *initiation*, *adoption*, and *implementation* (Zmud, 1982; Pierce et al., 1977; Rogers, 1982). Though other stage models exist for user-based innovation process, this particular model was chosen for the study since it is simple, yet discrete enough to delineate the variation in the impact of several factors.

Initiation stage includes the period when organizations sense a need or scope for improvement, scan the environment for the relevant information about the possible solutions, evaluate the information, and select a solution. Adoption stage includes activities pertaining to arriving on a decision mandate and allocating resources for the implementation of the product or solution, after having identified one. In the case of ERP system implementations, identifying an implementation partner is expected to follow the decision for implementing an ERP system. Therefore, the adoption stage also includes the selection of the implementation partner as well. Implementation stage includes activities associated with putting the innovation to use. The activities include business process mapping, configuration of the system to the organizational requirements, training the target users and getting the system operational, which is generally referred to as "go live".

2.2 Type of innovation

Type of the innovation is an important characteristic to be considered while studying the impact of the factors especially the organizational factors on the user-based innovation process (Daft, 1978; Swanson, 1994; Damanpour, 1991; Damanpour, 1987; Kimberly et al., 1981; Downs et al., 1976). An innovation may be classified as technological[*] or administrative innovations based on the type of change associated with the innovation. Technological innovations are those innovations that bring about changes in the

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[*] Some of the researchers have used the term "technical innovation" in a similar sense. The terminology is ambiguous. For example, the term "technological innovation" is being used for the classification in one study by Damanpour (1987) and the term "technical innovation" is being used in another study by Damanpour (1991). The present study considers the terminology implying the same meaning as being mentioned and uses the term technological innovation to avoid ambiguity

technology of the organization that is, a tool, technique, physical equipment, or system by which the employees, units or organization extend their capabilities (Damanpour, 1987). It can be an idea for a new product, process or service, which is directly related to the basic activity of an organization (Daft, 1978; Damanpour, 1987). Administrative innovations on the other hand, are the innovations that change an organization's structure or administrative processes. Administrative innovations are indirectly related to the basic activity of an organization and are more immediately related to its management (Damanpour, 1987). They usually pertain to the policies of recruitment, allocation of resources, and structuring of tasks, authority, and reward (Daft, 1978). Since implementation of ERP systems is a costly and strategic initiative and serves the administrative core more than the technical core, they can be classified as administrative innovations.

2.3 Effort

Many indicators of effort associated with developing, implementing and maintaining the information systems are being documented in the literature. These indicators include line of code, functional points, and man-hours. Implementation process of ERP systems offers a different context when compared to the traditional processes associated with the development and implementation of information systems in organizations (Ahituv et al., 2002). Most of the ERP systems are not developed from scratch. The contextual factors that influence the effort in the case of ERP system implementations are considerably different from those that are used in the traditional IS development literature (Francalanci, 2001). In case of ERP systems, implementation complexity arises considerably due to organizational factors apart from the technical factors of implementation. For this study, the time period associated with individual stages, that is, initiation, adoption, and implementation, and perceptual measures on the extent of deviation of the timeline from the planned one, and the extent of effort extended by the relevant groups are being considered as indicators of the associated effort.

2.4 Centralization

Centralization is defined as the extent to which power is distributed among social positions (Dewar et al., 1980). A decentralized set-up is expected to facilitate the flow of innovative ideas upwards from bottom. However, from the perspective of the dual core model of innovation, since the technical core is usually placed below the administrative core, the bottom-up flow would be necessary for technological innovations rather than administrative innovations (Daft, 1978; Kimberly et al., 1981). Therefore, a decentralized set-up may not especially contribute to the initiation of an administrative innovation such as an ERP system. Rather, a centralized set-up may be more suitable in such a case, since the administrative core would be well placed and active in exploring the solutions for administrative problems and determination of organization policies. The adoption process of an innovation is a political activity and necessitates bargaining (Zmud, 1982; Pierce et al., 1977). A decentralized set-up is usually characterized by the presence of heterogeneous reference groups (Zmud, 1982). Therefore, it is likely that there will be difficulty in reaching an accord on the innovation proposal. Rather, a centralized set-up is likely to facilitate the adoption process with the presence of a dominant coalition. In the case of implementation stage of implementation, there seems to be some confusion on the influence of centralization. A decentralized set-up, which reflects the participation of the organizational members in decision-making, is likely to have a positive influence on the implementation stage. Organizational members tend to accept the innovation readily, since the decision has been made, based on collective understanding (Pierce et al., 1977). On the other hand, if there is no proper hierarchy of authority, which is a characteristic of centralized set-up, there could be difficulty in the delineation of tasks and lack of accountability for the tasks. In such a situation, there could be difficulty in achieving efficient channelization of efforts. This

might negatively influence the implementation stage of the innovation. Testing the effects of the sub-constructs of centralization proposed by Hage and Aiken (1967) namely, *participation in decision-making* and *hierarchy of authority*, separately may help in gaining more clarity on the influence of centralization on the implementation of the innovation. The expected influence of centralization on effort at various stages of diffusion process is indicated in Figure1, Figure2, and Figure3

2.5   Formalization

Formalization is defined as the degree to which an organization emphasizes on following rules and procedures in the role performance of its members. Similar to centralization, the effect of formalization on the innovation process depends on the type of innovation and the phase of innovation. Following the same argument as in the case of centralization, since ERP systems are an administrative innovation, formalization along with centralization, is expected to have a favorable influence in the initiation, adoption, and implementation (Zmud, 1982; Damanpour, 1991). However, the influence is expected to be significant during the implementation phase, since formalization acts as a frame of reference for the associated organizational members. Typically, implementation phase involves active involvement of the organizational members other than senior management. The expected influence of formalization on effort at various stages of diffusion process is indicated in Figure1, Figure2, and Figure3.

2.6   Specialization

Specialization in an organization refers to the degree to which an organization's activities are divided into specialized roles. Specialization is expected to be positively associated with innovation process since greater levels of specialization provide a broader knowledge base and facilitate cross-fertilization of ideas (Kimberly et al., 1981; Damanpour, 1991). The positive influence was found to be stronger in the case of technological innovations than administrative innovations (Damanpour, 1987). Higher levels of specialization are likely to result in problems in coordination and control, which may serve as an impetus for the adoption of administrative innovations (Damanpour, 1987). Specialization, however, is expected to have a negative influence during the implementation phase of the administrative innovations due to the differences in the cognitive orientations among the specialized groups (Barki et al., 2005). The expected influence of specialization on effort at various stages of diffusion process is indicated in Figure1, Figure2, and Figure3.

2.8   Organizational absorptive capacity

Organizational absorptive capacity is defined as the ability of the organizations to recognize, assimilate and apply the relevant external knowledge for some beneficial ends (Cohen et al., 1991). An ERP system package embodies both business knowledge based on the best business practices as well as technical knowledge relating its use (Robey et al., 2002). Inducing ERP systems into an organizational system is comparable to inducing new external knowledge into the present system. With this logic, the present study proposes that absorptive capacity of the organizations has a significant favorable impact as indicated in Figure 1, Figure 2, and Figure 3, on the effort at all the stages of innovation process namely initiation, adoption and implementation. The two main components that contribute to the capabilities that constitute the absorptive capacity are: a) Prior related knowledge b) formal and informal Internal mechanisms that facilitate the knowledge flows within the firm (Cohen et al., 1990; Boynton et al., 1991; Jansen et al., 2005; Van Den Bosch et al., 1999). Prior related knowledge of the firm refers to the experience of the firm in implementing related or similar projects. Internal mechanisms, also known as

integrating mechanisms include formal and informal mechanisms enable knowledge exchange (Jansen et al., 2005; Van Den Bosch et al., 1999). Some of the integrating mechanisms include cross-functional interfaces such as liason personnel, task forces, and other teams that enable knowledge exchange, and the training programs.

2.9   Organizational publicness

Organizational publicness is defined as the extent to which the organization is influenced by the political authority. Political authority refers to the authority and support granted by the elements of the political system such as citizenry or governmental institutions. Three dimensions are being proposed that reflect the extent of influence of the political authority, namely, ownership, funding, and control (Bozeman, 1987; Perry et al., 1988). The first dimension of publicness based on ownership refers to the conventional scheme of classification based on legal ownership, wherein, organizations are more public if they are owned by the government and less public if owned by individuals. The funding dimension refers to the extent to which the organizations derive their budget from the government contracts or grants. Organizations that are more dependent on the government funds or contracts are considered to be more public. The control dimension reflects the level of influence that political forces or authorities have on the organization, in contrast to market or economic forces (Goldstein et al., 2005).

The conceptualization of organizational publicness has its origins from the public administration literature, which argues that the public and private organizations have significant differences in their distal as well as proximate environments (Bozeman et al., 1986). The generic management principles, which are being developed and applied successfully for the private sector organizations, cannot be plainly applied to the public management organizations. Majority of the literature used the classification based on the legal ownership to elicit the differences between the two sectors. This classification however, did not have any prescriptive value for the differences observed. Moreover, this approach for studying the implications of sector differences for various management related issues, does not account for the exceptions observed, that is, similarities across the sectors or the dissimilarities existing within a sector (Perry et al., 1988). To overcome this limitation, organizational publicness is conceptualized as a dimensional construct, and organizations can be placed in a continuum of publicness, as against a dichotomous categorization.

Drawing insights from the public administration literature, organizational publicness is expected to have a significant influence on the innovation process. As being highlighted by Damanpour (1991), "The distinctions between the public and private sectors produce useful insights into differences in strategies for innovation, the effect of structure, and incentive systems that induce organizational members to initiate and implement innovations" (p. 560). Organizational publicness is proposed to moderate the relationships between the structural factors and the effort associated with the initiation, adoption, and implementation of the ERP systems, as shown in Figure1, Figure2, and Figure3. The influence is proposed to be negative, in that greater organizational publicness overshadows the positive impact of the factors and intensifies the negative impact.

2.10   Control variables

Control variables considered for this study include organizational size, and project related factors such as scope of implementation, infra-structural difficulties, levels of misalignment, and integration with other systems. While organizational size is being used as a control variable for all the three phases that is, initiation, adoption, and implementation, project related factors are used as control variables, only for the implementation phase.

3   RESEARCH MODELS

The proposed models for predicting the influence of various organizational factors on initiation, adoption, and implementation effort are shown below in Figure 1, Figure 2, and Figure 3 respectively.
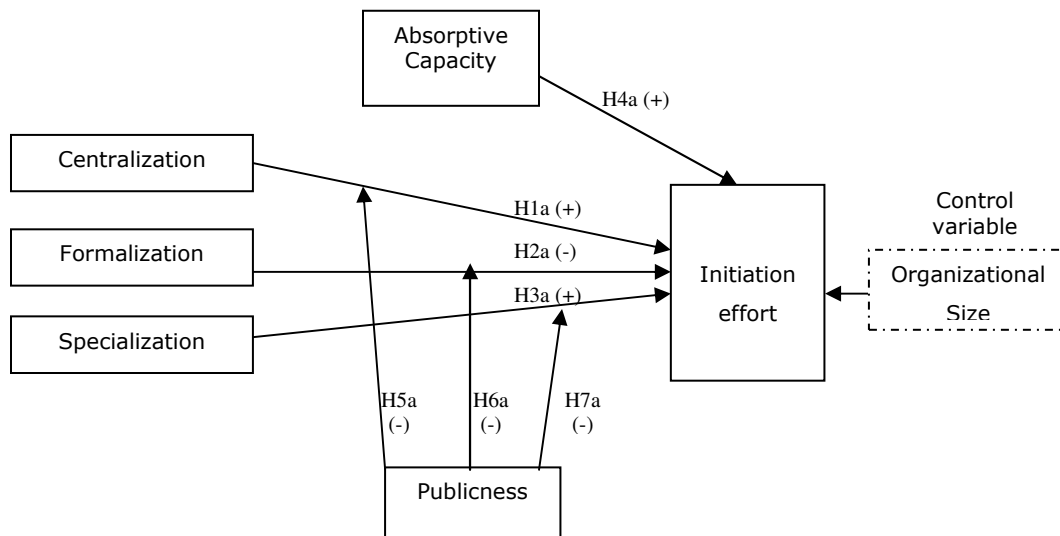
3.1   Model 1

Figure 1.   Model for predicting the effort associated with the initiation stage
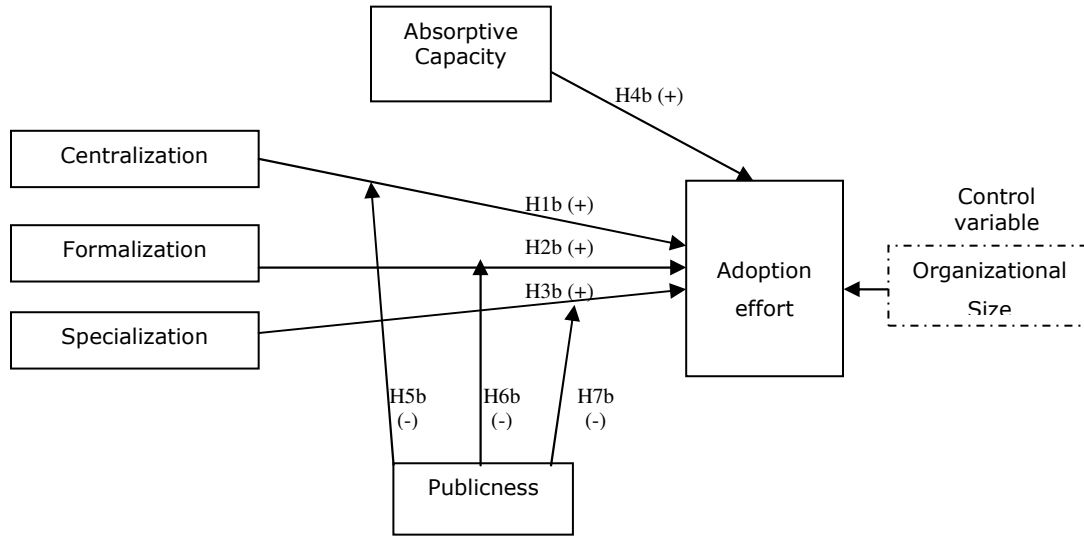
3.2   Model 2

Figure 2.   Model for predicting the effort associated with the adoption stage
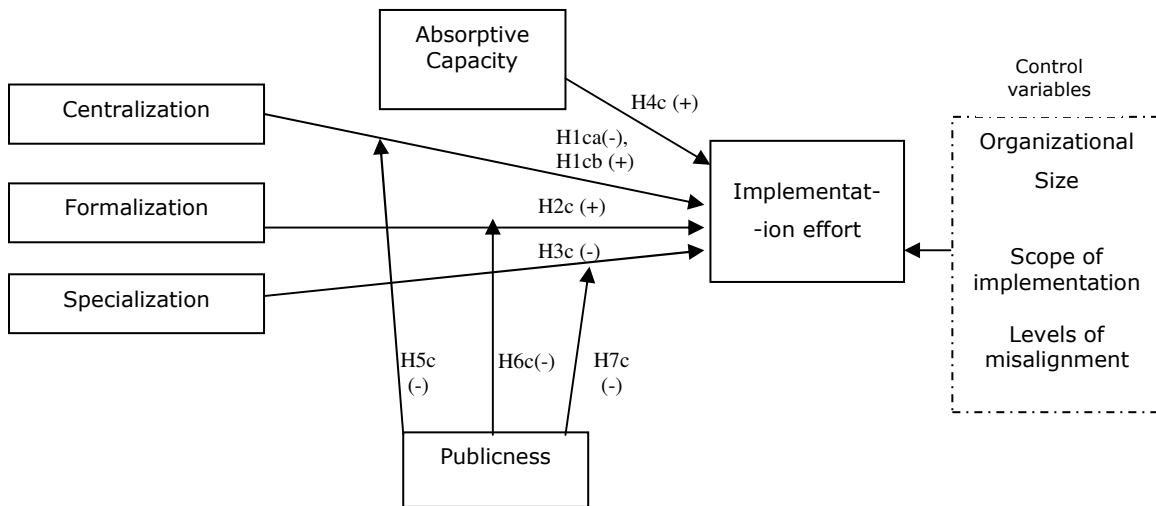
3.3   Model 3

Figure 3.   Model for predicting the effort associated with the implementation stage

4.   RESEARCH METHODOLOGY

4.1   Measurements and Data collection

Definitions and operationalization of the constructs that are used in the research models are based on relevant literature with revisions where appropriate. Items to measure centralization and formalization are derived from Hage and Aiken (1967). Items to measure specialization are derived from Subtahmanian and Nilakanta (1996). Instrument for measuring the organizational publicness is developed based on the insights offered by Bozeman (1987) and Goldstein and Naor (2005). Instrument for measuring the organizational absorptive capacity is derived from the study of Jansen, Van Den Bosch and Volberda (2006). Effort, as discussed in the earlier section of the paper, is operationalized as duration of each stage as represented by the relevant activities, the extent of deviation of the actual timeline from the planned one and perceptual measures on the effort expended by the relevant groups. The number of employees at the time of the implementation of the ERP system measures organizational size. The project related factors generally consist of the objective data.

The data will be collected using the survey method using two questionnaires. The units of analysis would be organizations, which have embarked on the ERP system implementation. There will be three informants organization, that is, core implementation team member, a managerial level employee from Finance department and a managerial level employee from Sales or Marketing department. Having multiple informants can be useful in overcoming the single respondent bias especially in the case of the latent organizational variables. Both online and postal surveys will be administered for data collection.

4.2   Data analysis

Partial least squares (PLS) method is expected to be used for the data analysis, since some of the constructs used in the framework are formative, in which case, PLS method is a recommended method (Gefen, 2000). Since the unit of analysis is organization, procuring a sufficient sample size for stable results and generalization may be difficult.

5.   CONTRIBUTION OF THE STUDY

The present study is expected contribute significantly to theory and practice. The study would be a significant contribution in understanding the user-based innovation process of ERP systems, generally referred to as ERP systems implementation process. As suggested by Kwon and Zmud (1983): "It seems likely that the factors influencing IS implementation process possess divergent impacts on the various implementation stages. These differences may be explained through interactions among factors and/or relations among stages. Accordingly, research investigating (1) interactions of factors within a stage and (2) relations among stages is also advocated" (p. 244)
Though the present study does not address any of the above-mentioned suggestions discretely, the insights that it may offer are expected to be an incremental contribution for research in the proposed directions.

Further, by examining the influence of organizational variables, the study aims to validate the findings and assertions from the organizational innovation studies. Such a validation would serve as an impetus in extending the well-established concepts from organizational innovation studies to the IS context. The insights offered by the constructs of absorptive capacity and publicness in the case of ERP systems implementation can be another significant contribution to the IS theory.

The predictive models incorporating the organizational characteristics would be a significant contribution for the practitioners who would be embarking on the implementation of the ERP systems. The insights offered by the organizational, contingent and project related factors are expected to contribute to the awareness of the various factors and their divergent impacts at various stages of ERP systems implementation process and accordingly, the need to introduce different organizational mechanisms, which tend to promote innovative behaviors at different stages of implementation process.

6. LIMITATIONS OF THE STUDY

The limitations of the study can arise from the assumptions being made and the methodology used. Firstly, the differences among the ERP application packages are not accounted for in the study, but in reality, there might be considerable differences in their features such as functionality, cost, and maintenance effort, which may influence the implementation process. Secondly, only a limited set of factors, which are being considered as important from the case study and from the literature have been considered in the framework. Environmental factors such as uncertainty, competition, and levels of regulation, which may influence the implementation process have not been considered. Industry specific variables are not accounted for, to keep the framework simple, as an initial effort. Many other organizational factors, apart from those being considered in the study may influence the implementation process considerably. For example, attrition of the key employees involved in the project during the implementation process (Palaniswamy et al., 2000). Another category of variables not being considered are the innovation roles such as *champion*, *idea generators*, and *gatekeepers* (Dewett et al., 2007) which are likely to influence the innovation process.

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