On the Evaluation of Companies Maturity for Implementing Strategic Information Systems Planning

Sobre a Avaliação da Maturidade das Empresas para Implementação do Planejamento Estratégico de Sistemas de Informação

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ABSTRACT
Social representation for managers and programmers about the degree of managerial maturity of a company in the planning of a strategic information system is studied. We will apply the concepts of Item Response Theory in order to assess how each item of management assessment is present in the organizational environment, given its weight in the planning process of the Strategic Information System Planning. The proposed model is applied in a large company in the area of information and communication technology and nationwide, reaching results and interpretations considered consistent by the company's professionals.

Keywords: Strategic Information Systems Planning, knowledge management, strategic management.

RESUMO
É estudada a representação social para gestores e programadores sobre o grau de maturidade gerencial de uma empresa no planejamento de um sistema de informação estratégico. Aplicaremos os conceitos da Teoria de Resposta ao Item com o objetivo de avaliar como cada item da avaliação da gestão está presente no ambiente organizacional, dado seu peso no processo de planejamento do Planejamento Estratégico de Sistemas de Informação. O modelo proposto é aplicado em uma grande empresa da área de tecnologia da informação e comunicação de âmbito nacional, alcançando resultados e interpretações consideradas consistentes pelos profissionais da empresa.

Palavra-chave: Planejamento Estratégico de Sistemas de Informação, Gestão do conhecimento, gestão Estratégica.
1 INTRODUCTION

Strategic Information Systems Planning, also known as SISP, is an organizational tool that allows directors to analyze data that will indicate how well the company is, what is the best attitude to take when we find ourselves in an environment that is constantly changing or in which changes are a little bit slower (ALTAMEEM, 2014). Uncertainties addressed and analyzed by SISP have some common characteristics as: variability and unpredictability of dynamic components; heterogeneity of components and shortage of resources and how fierce the competition in the market is.

The importance of having information planning is precisely being able to manage it. Know how to use the information that is at our disposal. Otherwise, all the work done may fail, or simply fail to achieve the expected goal. In fact, although the Strategic Information Systems Planning (SISP) has been emerging for large firms, family businesses do not develop strategic planning and they do not support business goals using Information Systems (KAMARIOTOU & KITSIOS, 2019).

In this work, it is considered that managerial maturity is assessed based on the degree of knowledge of certain actions performed by a professional or the degree of presence of certain practices in an company involving the degree of knowledge about the planning of strategic information systems, taking into account their due weight of each action or practice in characterizing the full success of the implementation of such a planning.

2 STRATEGIC INFORMATION SYSTEMS PLANNING

The classical proposal of SEGARS & GROVER (1998) apup TUNUGUNTLA (2017) that we can analyze the environment in two ways, depending on its characteristics, in order to obtain the best way to achieve success through SISP, classifies the environment as Incremental or Comprehensive.

| Characteristics         | INCREMENTAL SISP                                                                 | COMPREHENSIVE SISP                                                                 |
|-------------------------|---------------------------------------------------------------------------------|----------------------------------------------------------------------------------|
| Analyze                 | Informal Analysis                                                              | Formal Analysis                                                                  |
| Integration with business strategy. | The Information System Plan is rarely integrated with the business strategy | The Information System Plan is strongly integrated with the business strategy. |
| Review of the SISP Plan. | The SISP plan is continuously reviewed and adapted to suit the circumstances. | The SISP plan is reviewed periodically to adapt to the circumstances.            |
| Basic Representation.   | Its base is represented only by a few individuals                              | Its base is represented by several organizations.                                |
| Simplicity Vs. Complexity | Simple Plan                                                                    | Complex Plan                                                                     |

**Table 1** shows the main characteristics of each of both:

An informal or formal analysis can be chosen. In one hand, planning is based on a trust based on a certain personal experience, on a judgment, while in the second case, the analysis is made based
on multiple analyzes, which makes it a better-defined planning. On the other hand, integration with the business strategy, we observed that the incremental planning reflects only the business plan, while the comprehensive plan can cover the entire strategic plan.

A third characteristic, revision of the SISP plan, reveals that when we use the incremental SISP the planning is continually revised, adapting to changes throughout the project. When the comprehensive model is used, the review is made periodically, and may be monthly, quarterly or even annually. For the latter case, the changes that should be adopted are often no longer required or no longer enough to generate success in the project. Thus, we must use the comprehensive SISP, especially when we are in an environment where changes are not so dynamic and the predictability of events is high, thus making comprehensive Strategic Information Systems Planning more efficient.

For the fourth characteristic, the planning is based on key people considering a small number of individuals, while in the comprehensive SISP, the planning is based on a formal representation, composed of several organizations.

The last characteristic, it can be said that it is the result of the evaluation of the first four. Thus, the incremental SISP has a greater emphasis on informality and negotiations. While the comprehensive SISP has a greater emphasis on structures and methods. The classical study of NEWKIRK & LEDERER (2006) apud KAMARIOTOU & KITSIOS (2019) obtained from the Principal Component Analysis a set of four Factors indicative of the success of SISP and the questions (practices or actions) that characterize these factors shown in Table 2.
Table 2 - Main factors that characterize the success of SISP.

| Item                                                                 | Mean | SD  |
|----------------------------------------------------------------------|------|-----|
| Alignment                                                           |      |     |
| Understanding the strategic priorities of top management            | AL1  | 3.97| .79 |
| Aligning IS strategies with the strategic plan of the organization  | AL2  | 3.85| .77 |
| Adapting the goals/objectives of IS to changing goals/objectives of  | AL3  | 3.84| .81 |
| the organization                                                    |      |     |
| Maintaining a mutual understanding with top management on the role   | AL4  | 3.70| .81 |
| of IS in supporting strategy                                       |      |     |
| Identifying IT-related opportunities to support the strategic        | AL5  | 3.80| .79 |
| direction of the firm                                               |      |     |
| Educating top management on the importance of IT                    | AL6  | 3.59| .85 |
| Adapting technology to strategic change                             | AL7  | 3.64| .75 |
| Assessing the strategic importance of emerging technologies         | AL8  | 3.47| .83 |
| Analysis                                                            |      |     |
| Understanding the information needs of organizational subunits      | AN1  | 3.61| .85 |
| Identifying opportunities for internal improvement in business       | AN2  | 3.61| .84 |
| processes through IT                                               |      |     |
| Improved understanding of how the organization actually operates    | AN3  | 3.63| .76 |
| Development of a “blueprint” which structures organizational         | AN4  | 3.13| .96 |
| processes                                                            |      |     |
| Monitoring of internal business needs and the capability of IS to    | AN5  | 3.30| .76 |
| meet those needs                                                    |      |     |
| Maintaining an understanding of changing organizational processes    | AN6  | 3.30| .88 |
| and procedures                                                      |      |     |
| Generating new ideas to reengineer business processes through IT     | AN7  | 3.53| .84 |
| Understanding the dispersion of data, applications, and other        | AN8  | 3.56| .90 |
| technologies throughout the firm                                    |      |     |
| Cooperation                                                         |      |     |
| Avoiding the overlapping development of major systems               | CO1  | 3.94| .95 |
| Achieving a general level of agreement regarding the risks/tradeoffs| CO2  | 3.55| .86 |
| among system projects                                              |      |     |
| Establishing a uniform basis for prioritizing projects              | CO3  | 3.35| .95 |
| Maintaining open lines of communication with other departments      | CO4  | 3.73| .83 |
| Coordinating the development efforts of various organizational       | CO5  | 3.43| .88 |
| subunits                                                            |      |     |
| Identifying and resolving potential sources of resistance to IS      | CO6  | 3.39| .88 |
| plans                                                                |      |     |
| Developing clear guidelines of managerial responsibility for plan    | CO7  | 3.56| .90 |
| implementation                                                      |      |     |
| Improvement in Capabilities                                         |      |     |
| Ability to identify key problem areas                               | CA1  | 3.84| .62 |
| Ability to identify new business opportunities                      | CA2  | 3.70| .72 |
| Ability to align IS strategy with organizational strategy           | CA3  | 3.93| .84 |
| Ability to anticipate surprises and crises                          | CA4  | 3.38| .77 |
| Ability to understand the business and its information needs        | CA5  | 3.90| .68 |
| Flexibility to adapt to unanticipated changes                       | CA6  | 3.53| .81 |
| Ability to gain cooperation among user groups for IS plans          | CA7  | 3.68| .78 |

Source: NEWKIRK & LEDERER (2006) apud KAMARIOTOU & KITSIOS (2019)
Table 3 shows the loadings for each item by factor as calculated by NEWKIRK & LEDERER (2006).

Table 3 - Loads for the various factors extracted from the Principal Component Analysis.
Source: NEWKIRK & LEDERER (2006) apud KAMARIOTOU & KITSIOS (2019)

### 3 ASSESSMENT OF ORGANIZATIONAL MATURITY

We will use the Rasch Model (Equation 1) that relates the probability of full service to an item \( P(q) \), the degree of importance of this item and the \( q \) ability of the company manager to perform the action related to the item (ANDRADE, 2000).

\[
P_i(\theta) = \frac{\exp(\theta - b_i)}{1 + \exp(\theta - b_i)}
\]

Thus, the greater the probability that the agent fully meets the evaluated item (correct the item). Therefore, if the agent met 100% of item \( i \), it is because his ability \( q \) exceeded the \( b_i \) difficulty of item \( i \). Conversely, if he made a mistake, it is because his ability \( q \) was lower than the \( b_i \) difficulty of item \( i \). The estimation of skill \( q \) is made considering the probability \( P_i(q) \), right or wrong, and the \( b_i \) difficulty of item \( i \), and finding the value of skill \( q \) that balances this relationship.
The calculation of the degree of Maturity is obtained from the determination of Expected Value of $n$ properly normalized factors.

For that, we must divide the sum of the expected values of all items by the sum of the importance of all items. Thus, the maturity for each of the managerial skills (administrative, personal and technical) is:

$$Maturidade = \frac{\sum_{j=1}^{N} E_j(x)}{\sum_{i=1}^{N} b_i}$$  \hspace{1cm} (2)

4 METHODOLOGY

A case study was carried out within a large Brazilian telecommunications Carrier. For this study, a questionnaire was applied on a Likert scale from 1 to 5, what their perception was in relation to some items associated with strategic planning.

The scale used (scale with odd number of points) was chosen because it was the one that best fit our needs. This is because the respondent, when responding to a survey with this format, tends to move away from the extremes (the so-called central trend effect), which leads to disregard scales with only three positions, as there would be a strong tendency to neutral position, emptying the result of the evaluation. On the other hand, very wide scales with nine or more positions make it difficult for the respondent to choose, due to the small variation between one position and another.

It is considered that a maturity level can be evaluated from a degree of presence of certain factors and their loads (weights) that characterize maturity (Table 3). In this work proposal, managerial maturity is considered based on the degree of knowledge of certain actions performed by a manager involving the degree of knowledge about strategic planning, considering their weights or loading factors called parameter $b$.

For parameter $b$, DE REZENDE GUEDES (2020), used the loadings obtained from the Principal Component Analysis that calculated similarly to the loadings of NEWKIRK & LEDERER (2006) (Table 3). However, to work in the same range of maturity, the values normalized, ranging from 0 to 100% to vary from -3 to 3, therefore, the new values for the level of difficulty of the practices were defined as:

$$b_i = (6 \times b_i^* - 3)$$  \hspace{1cm} (3)

Where $b_i$ is an index of difficulty in implementing the $i$-th practice; and $b_i$ is the Load Factor (0 to 100%).
The factors and their loadings indicate the management actions that are important for the characterization of each of the four types of skills (Alignment, Analysis, Cooperation, Capacity).

To estimate the \( q \) parameter, a questionnaire was applied to the company evaluated for its employees to respond. The objective is to raise the perception that each employee had in relation to their reality: their immediate boss, their work environment and their satisfaction. The data were tabulated and, with that, obtained the average of the answers for each item.

In this work, organizational maturity means how much the analyzed company has of each item. In the work by CARNEIRO et al. (2002), the parameter \( q \) represents organizational maturity in the implementation of TQM practices. In the work of DE REZENDE GUEDES (2020), organizational maturity means how much the analyzed company has of each item assessed. Theoretically this parameter can assume values of \(-\infty\) and \(+\infty\). In order to maintain the same scale of the level of importance \( b \), the variation of -3 to 3 was assumed again, therefore, the new values for the parameter \( \theta \) was defined as:

\[
\theta = \frac{(q' - 1) \times 3}{2} - 3
\]

where: \( q' \) is the answer to the questionnaire (from 1 to 5) and corresponds to the organizational maturity to apply the \( i \)-th practice; and \( q \) is the converted \( q' \) parameter (-3 to 3) and corresponds to the average of the responses obtained in the survey.

If the skill is greater than the difficulty (\( q > b \)), the probability of that item generating a favorable result contributing to the company's success is positive (\( P > 50\% \)). If the skill is less than the difficulty (\( q < b \)), there is a negative result, that is, a negative probability (\( P < 50\% \)). That is, the greater the knowledge about strategic planning in that evaluated factor, the greater the probability that that factor will be overcome. And the lesser the preparation of the company evaluated in the factor in question, the lesser the probability of the company not achieving the intended success.

First, one of the cells responsible for the design and implementation of the data network of a telecommunications company was contacted, which met the prerequisites of the research: consolidated company, large and with prominence in the telecommunications sector and with a wide number of employees.

After the invitation to answer the questionnaire was accepted, a day was set for the questionnaire to be answered. Previously, the questionnaire was sent to the area manager, via email, who redistributed it to the other colleagues. Thus, on the agreed day, at the employees' workplace, the
questionnaire was read and the doubts that arose were taken away. Then the questionnaire was answered by each of the interviewees and handed over to the interviewer.

5 RESULTS AND ANALYSIS

When calculating a general maturity, adding all the hopes, of all the questions and dividing by the sum of all b (difficulty index), we see that in the company object of the research it obtained 3.81 (General Maturity). The organizational maturity for each of the 4 factors is shown in Figure 1.

We will discuss in the following sections the results shown by Tables 4 to 7 the maturity details for each of the items that define the Factor. This will allow us to evaluate how the intensity of each item is influencing positively or negatively given Factor.

For this first factor, as shown in Table 4, when managers and managers are not aligned with the company's priorities, this makes it more difficult for the company to achieve success.

When, on a scale of 0 to 10, we see that the marks that were below 5 represent a lesser contribution of this aspect to achieve the success of SISP based on the “Alignment” factor. The aspects that were considered most relevant had a low hope index. However, only 6 parameters were below 5.

According to the result of the questionnaire, the first 6 items revealed that the respondents are not aligned with the company's priorities, as well as having difficulties in adapting the Information System to the company's objectives. However, they performed well when they were evaluated regarding the management tools, to look for how the company works. It was also found that they were proactive in developing new ideas for improving organizational processes and procedures. Thus, they were able to act in accordance with the organizational strategy even though they are currently not so aligned with the company's proposals (“alignment of the IS strategy with the organizational strategy”).

| Questions                                                                 | Loads |
|---------------------------------------------------------------------------|-------|
| Understanding of strategic priorities defined by management.              | 4.20  |
| Alignment of IS Strategies with the organization's strategic plan.        | 2.12  |
| Adaptation to IS objectives to modify the organization's objectives.      | 2.25  |
| Maintain the managers' mutual understanding regarding the IS positioning in the company's strategic support. | 2.34  |
| Identification of Information Technologies - Reports of opportunities to support the company's strategic directions. | 4.35  |
| Educate senior management on the importance of IT.                        | 4.79  |
| Understanding the needs of the sub organizational units (branches and other departments). | 8.18  |
| Identification of opportunities for internal growth in the business process through IT | 8.33  |
| Improve the understanding of how the company works.                       | 8.13  |
| Application of the Blueprint tool in the company's organizational structure (other analysis tools). | 6.16  |
| Monitoring internal business needs and the IS's ability to meet those needs | 5.45  |
| Maintaining an understanding of changes in organizational processes and procedures. | 5.45  |
| Creation of new ideas to restructure the business process through IT       | 8.03  |
| Avoid overlapping development of important systems.                      | 6.03  |
To be able to establish a comparison between the risks and the decision making of the projects in progress. 7.25
Establish standardization for priority projects. 8.10
Maintain continuous contact with other departments. 6.59
Coordinate the development of the efforts of the various organizational subunits (Branches). 7.38
Identify and resolve possible sources of resistance to the implementation of SI planning. 9.06
Development of clear managerial responsibility guides for implementation. 8.04
Ability to identify new business opportunities. 7.39
Ability to align IS strategies with organizational strategy. 5.65
Ability to understand business needs and their information. 7.39
Ability to win the cooperation of SI planning user groups 7.36

For the “Analysis” factor, performance was no longer as satisfactory. Only six items performed more than 5.0. The good performance of these six items ("Identification of Information Technologies - Reports of opportunities to support the company's strategic directions", "Educating senior management on the importance of IT", "Establishing a standardization for priority projects", "Identifying and resolve possible sources of resistance to the implementation of SI planning ", "Ability to identify new business opportunities ", " Ability to win the cooperation of groups of users of SI planning ") did little to make the company's maturity already at the optimum , because they had a relatively small weight when analyzed within this factor (Analysis).

In order to change this situation, the interviewees should focus their attention and start adapting the objectives of the Information System to the objectives of the company, without generating a disagreement between managers (from other cells of the organization).

As the study was carried out at the headquarters of this organization, we realized that there should also be a deeper understanding of the needs, the processes of the branches, which could lead to a better understanding of how the company works.

| Questions | Loads |
|-----------|-------|
| Understanding of strategic priorities defined by management | 4.96 |
| Alignment of IS Strategies with the organization's strategic plan. | 4.91 |
| Adaptation to IS objectives to modify the organization's objectives. | 3.22 |
| Maintain the managers' mutual understanding regarding the IS positioning in the company's strategic support. | 3.08 |
| Identification of Information Technologies - Reports of opportunities to support management company's strategic. | 5.85 |
| Educate senior management on the importance of IT. | 6.14 |
| Understanding the needs of the sub organizational units (branches and other departments). | 2.11 |
| Identification of opportunities for internal growth in the business process through IT | 1.27 |
| Improve the understanding of how the company works. | 1.62 |
| Application of the Blueprint tool in the company's organizational structure (other analysis tools). | 0.89 |
| Monitoring internal business needs and the IS's ability to meet those needs. | 1.05 |
| Maintaining an understanding of changes in organizational processes and procedures. | 0.54 |
| Creation of new ideas to restructure the business process through IT | 1.54 |
| Avoid overlapping development of important systems. | 3.87 |
| To be able to establish a comparison between the risks and the decision-making of the projects in progress. | 4.91 |
| Establish standardization for priority projects. | 3.81 |
Maintain continuous contact with other departments. 2.46
Coordinate the development of the efforts of the various organizational subunits (Branches). 3.61
Identify and resolve possible sources of resistance to the implementation of SI planning. 5.42
Development of clear managerial responsibility guides for implementation. 3.92
Ability to identify new business opportunities. 5.54
Ability to align IS strategies with organizational strategy. 3.49
Ability to understand business needs and their information. 4.34
Ability to win the cooperation of SI planning user groups 5.51

The Management Maturity for “Cooperation” factor, like the previous one, did not perform well. Basically, the same factors influenced the performance to be such. What this block of questions reveals to us is that the evaluated cell really has a great desire and capacity to improve the whole process in order to reach maturity.

But the bureaucracy of organizations ends up hindering the evolution of the organization: "Avoid the development of overlapping important systems". Often a process goes very well, however, due to technological developments, some systems are exchanged, some methodologies renewed, but there is not always training for such migration, which makes this transition often abrupt, making processes that were once simple, now complex.

Try to “establish a comparison between the risks and decision making of ongoing projects”, “Establish a standardization for priority projects”, “Maintain continuous contact with other departments” and “Identify and resolve possible sources of resistance to the implementation of planning SI” are actions that have contributed to the better performance of the company and consequently to achieve the objectives set.

Table 6 - Contribution of the items to the maturity of the “Cooperation” factor.

| Questions                                                                 | Loads |
|---------------------------------------------------------------------------|-------|
| Understanding of strategic priorities defined by management.             | 6.00  |
| Alignment of IS Strategies with the organization's strategic plan.        | 4.46  |
| Adaptation to IS objectives to modify the organization's objectives.      | 4.05  |
| Maintain the managers’ mutual understanding regarding the IS positioning in the company's strategic support. | 4.78  |
| Identification of Information Technologies - Reports of opportunities to support management company's strategic. | 7.44  |
| Educate senior management on the importance of IT.                       | 7.20  |
| Understanding the needs of the sub organizational units (branches and other departments). | 6.03  |
| Identification of opportunities for internal growth in the business process through IT | 5.87  |
| Improve the understanding of how the company works.                      | 5.25  |
| Application of the blueprint tool in the company's organizational structure (other analysis tools). | 4.74  |
| Monitoring internal business needs and the IS's ability to meet those needs. | 2.14  |
| Maintaining an understanding of changes in organizational processes and procedures. | 3.06  |
| Creation of new ideas to restructure the business process through IT      | 5.68  |
| Avoid overlapping development of important systems.                      | 0.89  |
| To be able to establish a comparison between the risks and the decision-making of the projects in progress. | 0.81  |
| Establish standardization for priority projects.                         | 1.24  |
| Maintain continuous contact with other departments.                      | 0.61  |
| Coordinate the development of the efforts of the various organizational subunits (Branches). | 0.90  |
| Identify and resolve possible sources of resistance to the implementation of SI planning | 1.48  |
The major contribution of Managerial Maturity for “Capacity” factor was a great desire and ability to improve the entire process to achieve maturity. From Table 7, the items “Identification of Information Technologies - Reports of opportunities to support the company's strategic directions”, “Educating senior management on the importance of IT”, “Understanding the needs of organizational subunits (branches and other departments)” , "Identifying opportunities for internal growth in the business process through IT", "Maintaining continuous contact with other departments", "Coordinating the development of efforts of the various organizational sub units (Branches)", "Identifying and resolving possible sources of resistance the implantation of SI planning ", show the good preparation that the cell has to evolve. However, 

Even knowing that the lack of time for development and training of specialized labor and the lack of support to carry out various organizational changes required for the implementation of strategic planning practices are also important problems found in the research evaluated. What was discussed in the previous paragraphs serves as a suggestion for a possible change in the organization. Changes in the organizational and cultural structure are essential if the company intends to reap the maximum benefits from the implementation of the SISP.

| Questions                                                                 | Loads |
|---------------------------------------------------------------------------|-------|
| Understanding of strategic priorities defined by management.             | 4.66  |
| Alignment of IS Strategies with the organization's strategic plan.        | 3.88  |
| Adaptation to IS objectives to modify the organization's objectives.      | 3.91  |
| Maintain the managers' mutual understanding regarding the IS positioning in the company's strategic support. | 3.21  |
| Identification of Information Technologies - Reports of opportunities to support management company's strategic. | 6.56  |
| Educate senior management on the importance of IT.                       | 5.85  |
| Understanding the needs of the sub organizational units (branches and other departments). | 7.69  |
| Identification of opportunities for internal growth in the business process through IT | 6.43  |
| Improve the understanding of how the company works.                      | 4.80  |
| Application of the blueprint tool in the company's organizational structure (other analysis tools). | 4.29  |
| Monitoring internal business needs and the IS's ability to meet those needs. | 3.59  |
| Maintaining an understanding of changes in organizational processes and procedures. | 3.19  |
| Creation of new ideas to restructure the business process through IT      | 4.79  |
| Avoid overlapping development of important systems.                      | 3.19  |
| To be able to establish a comparison between the risks and the decision-making of the projects in progress. | 4.61  |
| Establish standardization for priority projects.                         | 5.36  |
| Maintain continuous contact with other departments.                      | 1.85  |
| Coordinate the development of the efforts of the various sub-organizational units (Branches). | 3.61  |
| Identify and resolve possible sources of resistance to the implementation of SI planning. | 5.87  |
| Development of clear managerial responsibility guides for implementation. | 3.78  |
### 6 CONCLUSION

This work aimed to adapt a method to measure, from the perception of managers and managers in the project area and implementation of a data network of a company in the telecommunications sector, the degree of managerial maturity, through the strategic information planning system.

We considered the factors, requirements and loads that assessed the degree of knowledge of managers and managers regarding some actions related to strategic planning. The questions that were analyzed for the factors Alignment, Analysis, Cooperation and Capacity showed that many times, when certain knowledge has not reached its optimum maturity, it influences others to have a poor performance.

The result shows that, we can assess the managerial maturity of a company from the assessment of the capacity and knowledge of managers and managers. And based on this assessment, put into practice plans and strategies to improve weaknesses. But for this it is essential that each employee of the company has in mind the importance of each item in the global context of the company.

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