Analysis of the graduate and postgraduate courses demand on Feira de Santana industry

Análise da demanda dos cursos de pós-graduação e pós-graduação na indústria de Feira de Santana

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Abstract

The municipality of Feira de Santana plays a pivotal role in the economic growth in the state of Bahia. According to data from the Brazilian Institute of Geography and Statistics (IBGE), the municipality has approximately 624,000 inhabitants and a Gross Domestic Product (GDP) of around 15 billion Brazilian reais annually, ranking as the 3rd largest in Bahia and the 74th in Brazil. To ensure the continuous economic growth of the municipality, there is a pressing need for a qualified workforce. Therefore, the aim of this study is to systematically examine and analyze the demand for undergraduate and postgraduate programs in the industry of Feira de Santana. The methodology employed was based on data collection, incorporating both qualitative and quantitative approaches, from industries located in Feira de Santana and the microregion within the Portal do Sertão. The project's development encompassed six stages: 1 – selection of the data collection instrument; 2 – formulation of a questionnaire with closed-ended questions; 3 – creation of an electronic questionnaire; 4 – data collection; 5 – data analysis; 6 – presentation of the study’s results at technical and scientific events. Results indicate a demand for undergraduate programs in Engineering or Management and a postgraduate program in the field of Management in the form of MBA specialization. It is noteworthy that currently, the Center for Science and Technology (CETENS) at the Federal University of Recôncavo da Bahia (UFRB) does not offer the community Management courses such as Administration, Accounting, or Economics, nor does it offer postgraduate courses in the same area. Thus, we identified two growth vectors in the project. The first is based on the ongoing expansion of Engineering/Technology courses, such as Chemical Engineering, Computer Science, Automation, and Architecture. The second vector is focused on management courses, as mentioned earlier. A study was conducted to understand the problems and difficulties encountered during the project's execution using quality tools such as Brainstorming (BS), Ishikawa, 5 Whys, 5W2H, and PDCA. A proposed solution was put forth for the continuation of activities. An analytical study was carried out, stratifying the 627 industries in Feira de Santana, and a recommendation of 27 undergraduate courses was suggested to meet this demand. Nevertheless, the results indicate the strengthening of the relationship between CETENS and the industry, a potential improvement in the future employability of CETENS graduates, and the proposal of guidelines for the development and introduction of new undergraduate and postgraduate courses at the advanced campus of CETENS/UFRB.

Keywords: Undergraduate. Postgraduate. Demand for Courses. Data Acquisition. New Courses.
Resumo
O município de Feira de Santana tem um papel central no crescimento econômico do estado da Bahia. Segundo dados do Instituto Brasileiro de Geografia e Estatística (IBGE), o município tem aproximadamente 624 mil habitantes e um Produto Interno Bruto (PIB) de cerca de 15 bilhões de reais anuais, situando-se no 3º maior da Bahia e no 74º do Brasil. Para garantir o crescimento econômico contínuo do município, há uma necessidade premente de uma mão de obra qualificada. Portanto, o objetivo deste estudo é examinar e analisar sistematicamente a demanda por programas de graduação e pós-graduação na indústria de Feira de Santana. A metodologia utilizada foi baseada na coleta de dados, incorporando tanto abordagens qualitativas quanto quantitativas, de indústrias localizadas em Feira de Santana e da microrregião do Portal do Sertão. O desenvolvimento do projeto contemplou seis etapas: 1 - seleção do instrumento de coleta de dados; 2 - formulação de questionário com perguntas fechadas; 3 - criação de questionário eletrônico; 4 - coleta de dados; 5 - análise de dados; 6 - apresentação dos resultados do estudo em eventos técnicos e científicos. Os resultados indicam uma demanda por programas de graduação em Engenharia ou Gestão e um programa de pós-graduação no campo da Gestão na forma de especialização MBA. Vale ressaltar que, atualmente, o Centro de Ciência e Tecnologia (CETENS) da Universidade Federal do Recôncavo da Bahia (UFRB) não oferece cursos comunitários de Gestão, como Administração, Contabilidade ou Economia, nem cursos de pós-graduação na mesma área. Assim, identificamos dois vetores de crescimento no projeto. O primeiro é baseado na expansão contínua de cursos de Engenharia / Tecnologia, como Engenharia Química, Ciência da Computação, Automação e Arquitetura. O segundo vetor está focado em cursos de gestão, como mencionado anteriormente. Um estudo foi realizado para entender os problemas e dificuldades encontradas durante a execução do projeto usando ferramentas de qualidade como Brainstorming (BS), Ishikawa, 5 Whys, 5W2H e PDCA. Foi proposta uma solução para a continuação das atividades. Realizou-se um estudo analítico estratificando as 627 indústrias de Feira de Santana e sugeriu-se a recomendação de 27 cursos de graduação para suprir essa demanda. No entanto, os resultados apontam para o fortalecimento da relação entre o CETENS e a indústria, uma potencial melhoria na futura empregabilidade dos graduados do CETENS e a proposta de diretrizes para o desenvolvimento e introdução de novos cursos de graduação e pós-graduação no campus avançado do CETENS/UFRB.

**Keywords:** Graduação. Pós-Graduação. Demanda por Cursos. Aquisição de Dados. Novos Cursos.
Introduction

Feira de Santana is considered a metropolis within the microregion known as Portal do Sertão, which is located in the state of Bahia (BA) and encompasses 17 municipalities. According to the Brazilian Institute of Geography and Statistics (IBGE) and the Superintendence of Economic and Social Studies (SEI), the Portal do Sertão has a territorial area of 5,812 km² and an estimated population of 961,900 inhabitants in the 2021. This microregion consists of both rural and urban zones, accommodating significant industries such as the O Boticário Group, Vipal, G-Light, Pirelli, Netlé, Pepsico, Belgo, Placo, among others. Feira de Santana is the largest municipality within the aforementioned territory, with an area of 1,304.425 km² and an estimated population of 625,107 inhabitants, according to IBGE (IBGE, 2021).

Feira de Santana is the second-largest urban center in the state of Bahia (the first is the capital Salvador), and one of the most significant cities in the country. Also, the commerce stands out as the economic pillar, accounting for a substantial portion of its Gross Domestic Product (GDP) at 61.3%. With an approximate value of 13 billion Brazilian reais, the industrial sector follows closely at 22.44%, with public administration contributing at 15.71%, and agricultural commodities in fourth place at 0.52% (IBGE, 2022). The municipality has two major industrial hubs: the Subaé Industrial Center in the Tomba neighborhood (CIS Tomba) and CIS BR 324, in the highway BR 324, with the forthcoming addition of CIS Norte, incorporating several other factories throughout the municipal neighborhoods outside these hubs. Feira de Santana's industrial landscape is notably diversified, excelling in the production of a wide array of goods, including food products, transportation materials, electrical equipment, mechanics, chemicals, household utensils, clothing, textiles, furniture, machinery and equipment, auto parts, beverages, paper and cardboard, and aerospace components.

Currently, the Center for Science and Technology in Energy and Sustainability (CETENS), an advanced campus of the Federal University of Recôncavo da Bahia (UFRB) located in Feira de Santana, offers seven undergraduate programs and four postgraduate

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10 Santa Bárbara, Tanquinho, Anguera, Ipecaetá, Antônio Cardoso, Santo Estevão, Conceição da Feira, São Gonçalo dos Campos, Amelia Rodrigues, Terra Nova, Teodoro Sampaio, Coração de maria, Irará, Água Fria, Conceição do Jacuípe, Santanópolis e Feira de Santana (PORTAL DO SERTÃO, 2023) e (SEI BAHIA, 2023).
11 Bachelor's in Energy and Sustainability, Bachelor's in Production Engineering, Bachelor's in Materials Engineering, Bachelor's in Energy Engineering, Bachelor's in Assistive Technology and Accessibility Engineering, Technology in Food for Rural Education, and Bachelor's in Rural Education with Specialization in Natural Sciences, Mathematics, or Pedagogy.
The educational purpose of CETENS/UFRB is to provide high quality education to Feira de Santana’s community to shape proficient professionals capable of addressing the needs of industries, businesses, and the community. To achieve this objective, both hard and soft skills are fostered among students through the curriculum content, research projects, and extension activities offered within the academic programs.

Brazil currently faces an unemployment rate of approximately 11.6 million individuals, and a significant portion of domestic factories and industries report challenges in tracking and hiring a skilled workforce (CNI, 2023). A study conducted by the National Confederation of Industry (CNI) reveals that 66% of companies within the industrial sector speak out on the lack of qualified laborers. This scarcity of labor stands out conspicuously against the backdrop of such elevated unemployment levels, particularly in an industry that struggles to chart a path toward growth.

The recession experienced in 2015 and 2016, coupled with subsequent years of ‘sluggish’ economic performance exacerbated by the lingering effects of the COVID-19 pandemic, prompted many industries to downsize their staff and curtail recruitment efforts. Nevertheless, as the economy gradually rebounds, the shortage of qualified labor will likely impede this resurgence, hindering innovation within enterprises and negatively impacting competitiveness within the sector (CNI, 2023).

The CNI research further indicated that companies encounter difficulties in the sourcing of qualified labor across all levels, with production roles presenting a more formidable barrier. According to the survey, 96% of companies reported challenges in recruiting skilled operators, while 90% cited the greatest challenge as finding technically proficient personnel (CNI, 2023). Hence, in response to this latent demand, training and upskilling emerge as an important solution to cope with these problems. A less productive workforce may not directly impact costs of a company, but it tends to result in costlier products and reduced competitiveness due to a lack of innovation and development in its production processes (SAAD et al., 2023).

The ultimate aim of this research is to resolve the paradox characterized by high unemployment rates coexisting with the difficulty of finding a qualified workforce to local industries. Quality tools such as Ishikawa diagrams, the 5 Whys technique, and BS were

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12 Interdisciplinary Specialization in Environment, Technology, and Sustainability, Specialization in Agroecology and Social Technologies in Rural Education, Professional Master's in Scientific Education, Inclusion, and Diversity, and Professional Master's in Intellectual Property and Technology Transfer for Innovation
employed to investigate the root causes underlying the issue of low response rates to the questionnaires employed within the industrial sector of Feira de Santana regarding. Once potential root causes were identified, a countermeasure plan was developed with the assistance of the 5W2H tool, and its execution was guided by the PDCA cycle. In this manner, this study sought to systematically examine and analyze the demand for undergraduate and postgraduate courses in the Feira de Santana industry, aiming at formulating proposals for training programs to cope with this evident gap.

State of Art

Feira de Santana boasts a vehicular junction that interconnects four federal highways, namely BR 101, 116, 242, and 324, as well as four state highways, BA 052, 502, 503, and 504, all of which serve to stimulate the local commerce. According to data from the Feira de Santana Commercial and Business Association (ACEFS), the municipality assumes a leadership role within a larger region comprising 96 municipalities, with an approximate population of 2,705,634 inhabitants (ACEFS, 2022).

The municipality's economy is characterized by the predominance of commerce and services sectors. An examination of the Gross Domestic Product (GDP) in Feira de Santana over the past decade was conducted to assess its economic potential: the nominal GDP in 2010 amounted to approximately 6 billion Brazilian reais, and by 2020 it had risen to around 13 billion Brazilian reais. A superficial numerical analysis might suggest that Feira de Santana's GDP doubled in size over the course of a decade. However, taking into account the inflationary effects during this period, the values reported were adjusted to the 2020 base year using the IPCA (Consumer Price Index) as an adjustment factor (FIEB, 2015). Accordingly, the results obtained are illustrated in Figure 1.

Bearing in mind the inflation adjustment, one can distinguish a 16% economic growth over a span of ten years. It is evident that the Gross Domestic Product (GDP) exhibited an exponential ascent until the year 2014. Subsequently, it becomes apparent that the national economic crisis, which commenced in 2015, exerted a detrimental impact on the economic expansion of the municipality. The year 2018 witnessed a semblance of economic recovery, albeit in 2019, the GDP resumed a downward trajectory, a trend accentuated in 2020 due to the economic repercussions stemming from the COVID-19 pandemic (IBGE, 2022).

Throughout this decade, the economic performance of the agribusiness sector remained below 1%, whereas the public administration sector hovered around 16%,
displaying a propensity for growth. The industrial sector accounted for approximately 22% of economic activity, albeit with a downward trend over the course of the period, punctuated by a slight resurgence in the final two years. Meanwhile, the services sector constituted roughly 61% of economic activity, with a tendency toward growth over the decade, though experiencing a decline in the last two years (IBGE, 2022).

The Industrial Guide of FIEB shows 627 companies located in Feira de Santana (FIEB, 2023). This municipality has a diverse array of industries encompassing a total of 28 industrial sectors, among which the following stand out: building construction, manufacture of rubber and plastic products, food products, apparel accessories manufacturing, and manufacture of motor vehicles, trailers. These sectors collectively constitute a fertile ground for the employment of the skilled workforce delivered by CETENS (FIEB, 2023).

In the pursuit of problem-solving, various quality tools can be employed, with notable examples including Brainstorming (BS), Ishikawa, 5W2H, 5 Whys, and the PDCA cycle. It is well recognized that teamwork is by no means a straightforward endeavor. For this reason,
companies often apply group dynamics during their recruitment and selection processes, utilizing mechanisms such as BS - a technique introduced by the American thinker Alex Faickney Osborn in 1948 within his seminal work "Your Creative Power". BS is a widely embraced method among managers, marketing professionals, and market researchers. Qualitative market researchers, in particular, exhibit an extensive and creative application of BS and its various adaptations in their day-to-day practices. Osborn posits that, during the thought process, the brain engages in two distinct activities: I) envisioning, generating, and fostering ideas; and II) conducting a critical and comparative analysis. It has been observed that the critical analysis component may serve to inhibit and stifle the creative generation of ideas. Consequently, in Osborn's BS methodology, it is imperative to circumvent such inhibitory tendencies by segregating these two activities. One of the primary objectives of BS is to emancipate the mind, affording it unrestricted freedom to explore its creative potential (BODY, 2012).

BS postulates that a collective of individuals convenes and employs their cognitive faculties and conceptual contributions to converge upon a shared foundation, with the objective of engendering innovative ideas conducive to advancing a particular project (VANGUNDY, 2007). It is imperative that no idea is summarily rejected or adjudicated as erroneous or preposterous; instead, all ideas should be diligently incorporated or documented within the compendium of ideas generated during the process, subsequently evolving towards the ultimate solution (KAY, 1995).

For a BS session, it is imperative to adhere to several golden rules: I) debates and critiques of presented ideas are strictly prohibited, as they induce inhibitions (the more ideas, the better); II) no idea should be disregarded; in other words, individuals have complete freedom to discuss whatever they wish; III) for the smooth progress of the session, modified ideas or combinations of previously presented ideas should be reintroduced; and IV) equal opportunity - everyone must have a chance to articulate their ideas (CORRÊA, 2019).

The Ishikawa diagram, more commonly known as the "fishbone diagram", serves as a tool for identifying the root causes of problems. These diagrams are constructed by working groups involving all stakeholders in the analyzed process. Following the identification of the specific problem or effect under study, a list of potential causes is compiled for the creation of a cause-and-effect diagram (CORRÊA, 2019).

The Ishikawa diagram, also known as the "cause and effect diagram" or "tree or river diagram", was conceptualized by Dr. Kaoru Ishikawa, a professor at the University of Tokyo, in his book titled "What is Total Quality Control? The Japanese Way" (1985). Ishikawa states
that this diagram elucidates the relationship between quality characteristics and causal factors. This diagram constitutes a set of tools commonly referred to as the "Seven Basic Tools of Quality Control" (MCDERMOTT et al., 2022). The primary objective of the Ishikawa diagram is to ascertain the variability of a quality characteristic as an effect or consequence of multiple causes (ANTONY et al., 2021). It wholly centers on its causes, rather than its effects, thereby enabling the establishment of quality control from a process perspective. In this context, those responsible for the process take charge to identify the causes of variability and eliminate them by identifying all possible sources of inconsistency and subsequent loss of quality (SUÁREZ-BARRAZA; RODRÍGUEZ-GONZÁLEZ, 2019).

On the other hand, the 5W2H method represents the swiftest and most efficient means of resolution, as it comprises a set of interrogative prompts employed for the extraction of responses, applying the following inquiries: "What - What is it?"; "Why - Why is it so?"; "Where - Where does it occur?"; "How - How does it transpire?"; "When - When does it happen?"; and "How much - To what extent?". The investigation encompassing the 5W2H tool necessitates a structured approach, designed to facilitate the expedited and effective identification of essential components for the implementation of a project (ANDRADE, 2018).

The 5 Whys is a tool employed to extract and identify the root cause of problems, and its methodology is grounded in a process of questioning, specifically inquiring "why" as many times as necessary until arriving at the true cause or the so-called root cause (ANDRADE, 2018). The 5 Whys represents an interrogative iterative technique utilized to delve into the cause-and-effect relationships underlying a particular problem. It was conceived by Sakichi Toyoda and employed by the Toyota Motor Corporation during the evolution of its manufacturing methodologies. The fundamentals of this scientific approach entail repeatedly posing the "why" question five times concerning the nature of the problem, thereby elucidating the solution in a clear manner (MURUGAIAH et al., 2010). This tool has been widely employed in conjunction with other production methodologies such as Kaizen (BERHE, 2022), Lean Manufacturing (SAAD et al., 2023), and Six Sigma (AYAD, 2010).

The success of the 5 Whys technique is contingent upon the knowledge, competence, and experiential acumen of the analysts in orchestrating the appropriate sequence of inquiries to unveil the genuine root causes (BENJAMIN; MARATHAMUTHU; MURUGAIAH, 2015). However, on certain occasions, the 5 Whys technique may falter in yielding the desired outcomes, owing to the ensuing rationales: 1) a dearth of inclination among experts to delve further into the investigation, thereby disregarding the more profound root causes within the
subsystem that might be contributing to the emergence of the issue. II) the propensity to conflate symptoms with the authentic root cause of the problem. III) the incapacity or reluctance of specialists to venture beyond their specific domains of expertise when required. IV) the absence of result repeatability, as different individuals may discern distinct causes for the same problem by posing disparate queries. V) the challenge of applying established principles, as there are instances where well-known principles may not readily adapt to resolving a novel predicament (GANGIDI, 2019).

To mitigate a substantial portion of deviations during the analysis, it is imperative that the technique is conducted within the framework of BS philosophy and that the investigative team comprises multidisciplinary members from diverse fields, thus allowing for the problem's horizon to be extrapolated. However, the 5 Whys tool may elucidate potential root causes that will only be substantiated subsequent to the formulation of a countermeasure plan, its implementation, and the verification that the previously evident symptoms no longer persist (MURUGAIH et al., 2010).

The term PDCA, which stands for Plan-Do-Check-Act, represents a managerial method aimed at effectively overseeing processes in pursuit of continuous, incremental, and substantial improvements (RAJAGOPALAN, 2020). PDCA constitutes a fundamental concept for the ongoing enhancement of product quality and is the practical application of the Deming cycle. The PDCA cycle, often referred to as a circle or wheel, is a four-stage problem-solving process, consisting of: I) "Plan" (establishing new processes that yield the desired outcome); II) "Do" (implementing the new process); III) "Check" (measuring the results of a process and observing any variances between it and the desired outcome); and IV) "Act" (analyzing the disparity between the observed and expected outcomes, and subsequently taking corrective actions in the course. From this point, the cycle recommences for further improvements (RAJAGOPALAN, 2020).

Given all of the aforementioned considerations, it becomes evident that there is a palpable need for a skilled workforce to sustain and further catalyze the ongoing economic and technological expansion within the industrial and commercial sectors of Feira de Santana and its surrounding regions, as indicated by government metrics over the past decade. To address this, the present extension project is poised to elucidate the aspirations and requirements of enterprises operating within the commerce and industry domains. This will be achieved through the acquisition of data directly from the target audience, culminating in the construction of a robust database that will serve as the foundational basis for the
Methodology

The execution of this research was based in data collection from industrial and corporate entities located within the municipality of Feira de Santana and its surrounding regions, collectively constituting the microregion of Portal do Sertão. This project has been structured into six distinct stages, which are as follows: 1) Selection of the data collection instrument; 2) Development of the questionnaire comprising closed-ended questions; 3) Creation of an electronic questionnaire; 4) Data collection; 5) Data analysis; 6) Scientific data sharing at technical-scientific events. All the stages are summarized in Figure 2.

Figure 2. Stages for conducting research.
Data source: Author’s own work.

In the initial stage, a questionnaire was devised for the execution of individual interviews to enhance the data collection instrument. To accomplish this, the BS technique was employed with the aim of selecting the optimal data collection tool. Given the context presented, in the initial interactions with the organizations, it became evident that a questionnaire comprising closed-ended questions would be the most suitable choice to achieve the desired outcomes. The construction of the questionnaire elucidated all the data and information that needed to be gathered from the companies, and a BS session for formulating the questions was conducted. This was done to sequentially develop closed-ended questions in a manner that would narrow down the knowledge obtained into concise and meaningful responses geared towards addressing the issue at hand.

In the second stage, a comprehensive study of the needs of the industries and companies was undertaken. This began with data collection through a questionnaire consisting...
of 15 objective questions that were crafted to clarify the aspirations and challenges faced when recruiting qualified workforce. In the third stage, the discussion revolved around the means to be employed for the administration of the questionnaire. The electronic medium was chosen due to its capacity to reach a larger number of respondents in a straightforward, expeditious, and secure manner. It is noteworthy that virtual and electronic organizational activities were catalyzed and enhanced as a result of the COVID-19 pandemic, during which interpersonal contact was limited.

The selection was guided by the post-pandemic moment in which social distancing propelled the execution of activities that were traditionally conducted in person, such as meetings, lectures, classes, among others, to transition into virtual formats. In this vein, the electronic medium was chosen over print, considering that the print method is outdated. The electronic form provided by Google Forms was selected for being a useful tool, suitable for the intended purpose, and made available free of charge. However, during the project execution, several issues related to data acquisition were encountered and will be explored in a dedicated section.

Data collection commenced with the distribution of electronic questionnaires, thereby initiating the effective gathering of primary data for the study. To accomplish this stage, it was necessary to compile a database containing contact information for companies located in Feira de Santana and the Portal do Sertão microregion. In this regard, the Center for Industries of Feira de Santana (CIFS) and the Federation of Industries of the State of Bahia (FIEB) were contacted and provided the database of companies in the microregion under study. Consequently, it became feasible to establish a database comprising 378 companies situated in the Portal do Sertão microregion.

Finally, the data collected and stored in Google Sheets were exported to Microsoft Excel to facilitate the organization of the gathered information in an electronic spreadsheet through the creation of graphical representations. Subsequently, the sixth stage was realized through the presentation of interim findings at internal scientific events hosted by the UFRB, with the final results being presented in the current report.
Results and Discussion

4.1 An Analytical Examination of the Industrial Sector in Feira de Santana

According to data from the Feira de Santana Commercial and Business Association (ACEFS), the municipality leads a microregion encompassing 96 municipalities with a population of approximately 2,705,634 inhabitants (ACEFS, 2022). The municipality's economy is based predominantly on the commerce and services sectors (FIEB, 2023). However, the industrial sector has shown growth over the past few years, as evidenced by the increasing contribution of the industry to the municipality's GDP. The industrial sector has injected dynamism into the economy of Feira de Santana, surpassing the growth rate of the services sector in the past two years (see Figure 1). The prominent activities within the municipality account for 59 out of the 62 industrial segments in the Portal do Sertão microregion and are presented in Figure 3.

![Figure 3. The primary sectors of the Feira de Santana industry in quantitative terms.](Image)

Data source: (FIEB, 2023)

The Industrial Guide of the FIEB specifically delineates 627 industrial enterprises within the municipality of Feira de Santana, employing a total of 20,896 laborers (FIEB, 2023). Unlike several other regions within Bahia where one can discern a concentration of industrial activity in only a few sectors, Feira de Santana exhibits a greater diversity of industrial enterprises, encompassing a total of 59 distinct industrial segments. The magnitude and scale of the industrial sector in Feira de Santana is graphically depicted in Figure 4.
A study was conducted to stratify job generation in the region by industry size, and the results are shown in Figure 5. Approximately 86% of the companies in the municipality are classed as micro and small enterprises (refer to Figure 4), employing 29% of the total industrial workforce (FIEB, 2023). These entities are promising sites for the employability of a skilled workforce trained at a Federal University. Medium and large-sized enterprises, on the other hand, make up 14% of the businesses located in Feira de Santana; however, they employ 71% of the industrial sector's workforce.
### 4.2 Proposition of Undergraduated Programs to Meet the Demand of Society

A comprehensive analysis of the industrial landscape reveals the presence of 764 distinct industries within the Portal do Sertão, with a substantial concentration of 627 such industries located in the municipality of Feira de Santana. This examination has identified 62 distinct industrial sectors, all of which exhibit a compelling need for a skilled workforce to enhance their production processes, thereby ensuring their sustainability and potential expansion within the market. Notably, the region has been compelled to import qualified labor from other areas, primarily due to the scarcity of skilled workers within the Portal do Sertão. In light of these challenges and the imperative to foster competence and address the pent-up demand within the industrial sector, the following courses are hereby proposed, as outlined in Table 1.

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<td>Administration</td>
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<td>Architecture</td>
<td>To meet the demands of the 100 companies in the construction industry</td>
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<td>3</td>
<td>Accounting</td>
<td>To serve the entire industrial sector.</td>
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<td>Fashion Design</td>
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<td>Product Design</td>
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<td>Law</td>
<td>To serve the entire industrial sector</td>
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<td>Economy</td>
<td>To serve the entire industrial sector</td>
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<td>8</td>
<td>Civil Engineering</td>
<td>To meet the demands of the 100 companies in the construction industry</td>
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<td>Computing Engineering</td>
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<td>Food Engineering</td>
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<td>Energy Engineering</td>
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<td>Software Engineering</td>
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</tr>
<tr>
<td>18</td>
<td>Mechatronics Engineering</td>
<td>To serve the entire industrial sector</td>
</tr>
<tr>
<td>19</td>
<td>Metallurgical Engineering</td>
<td>To meet the demands of the 84 metallurgical industries.</td>
</tr>
<tr>
<td>20</td>
<td>Chemical Engineering</td>
<td>To meet the demands of the 25 chemical industries and 27 pulp and paper industries</td>
</tr>
<tr>
<td>21</td>
<td>Civil Engineering Technology</td>
<td>To meet the demands of the 25 chemical industries and 27 pulp and paper industries</td>
</tr>
<tr>
<td>22</td>
<td>Food Engineering Technology</td>
<td>To meet the demands of the 74 food industries.</td>
</tr>
<tr>
<td>23</td>
<td>Electrical Engineering Technology</td>
<td>To serve the entire industrial sector</td>
</tr>
<tr>
<td>24</td>
<td>Mechanical Engineering Technology</td>
<td>To serve the entire industrial sector</td>
</tr>
<tr>
<td>25</td>
<td>Chemical Engineering Technology</td>
<td>To meet the demands of the 25 chemical industries and 27 pulp and paper industries</td>
</tr>
</tbody>
</table>
Table 1. Proposal for undergraduated courses to meet the industry demand.
Source: Research Data.

<table>
<thead>
<tr>
<th>Course</th>
<th>Industry Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information Technology</td>
<td>To serve the entire industrial sector</td>
</tr>
<tr>
<td>Veterinary Medicine</td>
<td>To meet the demands of the 54 veterinary companies</td>
</tr>
</tbody>
</table>

4.3 Field Research in the Industrial Sector

Initial database construction started with the inclusion of 146 companies that had their registration with the CIFS. The continuous evolution of the database, with information sourced from the Feira de Santana Secretariat of Industry, Commerce and Tourism, enabled the attainment of a total of 378 registered companies within the database. This constituted the total number of companies contacted during the field research. Subsequently, the database was expanded to encompass 627 industries, with data obtained from the FIEB. An analytical study of sectors, industries, size, and employment generation was conducted to underpin the proposition of undergraduate courses aimed at meeting this demand.

For the initial contact with the industries, a questionnaire comprising 15 closed-ended questions was developed and gradually sent to each of the 378 companies spanning diverse sectors. Initially, email was adopted as the primary means for administering the electronic questionnaire, and it was dispatched to 241 industries/companies during the first three months of data collection. However, only 6 responded. Thereafter, we sought assistance from CIFS in sharing the survey form link and email with the industries. At this juncture, we observed that the companies were unfamiliar with CETENS/UFRB, and when they did recall it, they associated it with Cruz das Almas and the Recôncavo region, thereby diminishing their inclination to invest time in responding to the survey. Nonetheless, even with CIFS’s support in the digital realm, the number of questionnaire responses did not increase satisfactorily.

In parallel with the email initiatives, the company registration database was expanded to include fields for Linkedin, Instagram, and WhatsApp, as it was observed that closer contact with regional companies was necessary. Further, an internet search was initiated to identify the electronic addresses for each social media tool. Linkedin, being a social network oriented towards the industry, serves as a “conduit” for linking labor supply and demand. Accordingly, Linkedin was utilized with the intention of establishing more direct contact with the human resources departments of various companies. A total of 20 companies were contacted, though regrettably, no responses were received. Nevertheless, we introduced a third digital contact method, Instagram, a platform extensively employed by industries/companies; 30 companies were contacted, but only 4 responded.
Despite the efforts expended, due to the limited response to the intended approach, direct telephone contact was initiated. However, an unforeseen barrier emerged: the lack of updated contact numbers in the databases of CIFS and FIEB. Many contact numbers either did not exist or no longer belonged to the respective companies. As a result, a significant amount of time was devoted to online research to update the phone registry in the database. Initially, telephone contact yielded a promise of future questionnaire responses that did not materialize. Nevertheless, the impact of communication was heightened due to the wealth of information that telephone conversations could convey and the presence of tone of voice, which facilitated information reception.

Nonetheless, many questionnaires remained incomplete, marginally increasing the number of responses despite escalating efforts. To cope with this, a strategy was adopted, wherein attempts were made to complete the questionnaire during telephone conversations. Out of the 50 companies contacted in this manner, only 9 agreed to respond to the inquiries. The remaining enterprises cited time constraints but pledged to provide responses at a future time, a commitment yet to materialize to the present day.

The most effective method employed in the research was the technique of conducting on-site visits. The Belgo S/A company was visited, and the questionnaire was completed a week following the visit. This approach demonstrated itself as the most efficient and effective means of communication. In face-to-face interactions, besides textual information, a wealth of data is conveyed through vocal intonation and body language, which proved instrumental. During a technical visit, the transmitted information extends beyond the written content of the questionnaire, encompassing various distinct subjects, such as the origin of the CETENS/UFRB campus, the courses offered to the Feira de Santana community and the Portal do Sertão, the students' competencies, the faculty's capabilities, and existing institutional partnerships, among other topics. The limit of information imparted is delineated by the level of uncertainty and curiosity concerning the CETENS/UFRB advanced campus and the educational, research, and outreach activities conducted there.

However, the practical execution reality revealed significant barriers to achieving the intended outcomes. During the project's implementation using the objective questionnaire with closed-ended questions, no cooperation was garnered from industries and companies. Nonetheless, valuable information was derived from the extension project. With data obtained from the 20 responses, it became possible to recognize a trend in the profile of undergraduate programs that would meet these companies' demands. The results indicate that 35% require a skilled engineering workforce, while another 35% could be served by management courses.
Analysis of the graduate and postgraduate courses demand on Feira de Santana industry

(Economics, Business Administration, or Accounting). Additionally, 20% of participants indicated a need for technical courses, 5% require logistics courses, and 5% seek other courses, as depicted in Figure 6.

![Figure 6. Research outcome of the undergraduate course necessity research. Source: Research Data.](image)

On the other hand, as shown in Figure 7, participants' assessment within the research context concerning the postgraduate course profile that would meet the demands of their respective companies reveals that the field of management occupies the foremost position in the hierarchy of needs at 45%, followed by a tie for second place between engineering and technology at 20%. In the third position is the field of logistics, accounting for 10%, and lastly, the preference for any course profile stands at 5%, as shown in Figure 7.

![Figure 7. Research outcome on the necessity for postgraduate courses. Source: Research Data.](image)

The narrowing down of closed-ended questions in the questionnaire directed the research towards evaluating the industry-preferred format, assessing the alignment of the required course with the duration timeline, and the program's structure. The predominant choice among respondents was Specialized MBA programs, garnering 50% of the responses. Specialized MBA programs are characterized by their short duration, typically spanning 2
years, offering classes during evenings or weekends, and a specific focus on particular subjects. Notably, in a similar vein, professional master's programs ranked second among the available options in the questionnaire, capturing 20% of the responses. In third position were Doctoral programs and Technical Courses, each accounting for 10%. Other options, such as Academic Master's Degree and Any Postgraduate Studies, had 5% share each, as illustrated in Figure 8.

![Figure 8. Research findings regarding the structure of postgraduate programs.](Source: Research Data)

Despite its low statistical significance due to the limited response rate (approximately 5.29% of the target audience effectively responded to the questionnaire), the data obtained provides valuable insights into the workforce development needs in Feira de Santana. These insights point towards a direction for education and training, suggesting a focus on undergraduate programs in Engineering or Management and postgraduate studies in the field of Management, particularly in the form of MBA specializations.

It is worth noting that currently CETENS/UFRB does not offer undergraduate or postgraduate courses in Management to the community. Thus, our research identified two growth vectors: the first is based on the continuation of expanding Engineering and Technology programs, such as Chemical Engineering, Computer Science, Automation, and Architecture; the second vector emphasizes Management-related programs like Business Administration, Accounting, or Economics.

In an effort to understand the underlying reasons for the low response rate from industries in Feira de Santana and the Portal do Sertão region to the distributed electronic questionnaire, despite increasing efforts, we conducted a root cause analysis using various quality tools, including Ishikawa diagrams, the 5 Whys method, 5W2H, PDCA, and Brainstorming. The problematic issue was framed as follows: companies are not responding to the questionnaire. This issue was placed at the head of the Ishikawa Diagram, and the
resolution process began by synergistically employing the three quality tools—Ishikawa, 5 Whys, and Brainstorming—to exhaustively identify potential causes, represented as the "scales" on the Ishikawa Diagram, related to the final effect, which is the difficulty faced by companies in responding to the electronic questionnaire.

The approach began by questioning the aforementioned issue: Why are companies not responding to the electronic questionnaire? Using BS techniques, six primary causes that could lead to this effect were identified. For each of these six primary branches stemming from the main cause, the 5 Whys method was applied to systematically explore the answers through brainstorming. In some cases, it required more than five questions to reach a response that could not be further distilled into a question, thereby uncovering the root cause of each primary cause. For two of the six primary causes, it was possible to thoroughly explore the answers with fewer than five questions.

The results revealed a total of 25 responses to the 5 Whys questioning, indicating 25 possible causes, which gradually converged into four root causes: RC1 – reducing operational costs and maximizing profits; RC2 – CETENS is new in the city, and the courses are new without the appeal of traditional programs like Medicine and Law; RC3 – lack of proactive efforts by FIEB and CIFS to engage industries more actively; and RC4 – the electronic communication method is insufficient for companies to perceive the questionnaire's significance and allocate the necessary time for a proper response. The results obtained are shown in Figure 9 and Table 2, respectively.

Figure 9. Ishikawa diagram and the root causes of the effect: companies' non-response to the electronic questionnaire.
Source: Research Data
## Causes (scales) of Ishikawa diagram analysis

<table>
<thead>
<tr>
<th>Materials</th>
<th>Environment</th>
<th>Machinery</th>
<th>Workforce</th>
<th>Method</th>
<th>Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>C3 - Unfamiliar with CETENS</td>
<td>C13 - The lack of identity alignment between UFRB and the city of Feira de Santana, as well as with the Portal do Sertão region</td>
<td>C2 - A congested email inbox fails to discern significance</td>
<td>C1 - Lack of time</td>
<td>C18 - As electronic digital media diminishes the transmission channel of information, and the escalating demands discourage the expenditure of increasingly scarce time to respond to the questionnaire</td>
<td>C7 - Reduction of the workforce to streamline the functional structure</td>
</tr>
<tr>
<td>C12 - UEFS stands as the sole point of reference for a public university within the city of Feira de Santana</td>
<td>C16 - There is no substantial relevance attributed to the FIEB and CIFS in terms of their impact on the performance of business and industrial activities</td>
<td></td>
<td>C4 - Obsolete database entry</td>
<td>C19 - Despite the optimization of computational resources for enhancing data and information transmission capabilities, they inherently impose constraints on the perceptual aspects of information such as tone of voice and bodily expressions, among others</td>
<td>C8 - To mitigate worker idleness and lower the payroll expenditure</td>
</tr>
<tr>
<td>C14 - The failure of companies to update their information with FIEB and CIFS</td>
<td>C15 - Absence of active engagement within the FIEB and CIFS</td>
<td></td>
<td>C5 - Lack of direct contact with the HR representative.</td>
<td>C21 - The electronic digital medium diminishes the information transmission channel and is inherently incapable of independently demonstrating the cause-and-effect relationship of the questionnaire.</td>
<td>C11 - To maintain the workforce budget, the assignments per employee are increased</td>
</tr>
<tr>
<td>C17 - Because electronic digital communication results in a notably impersonal interaction, individuals within the corporate sector fail to recognize the significance of the research endeavor</td>
<td>C10 - The failure lies in recognizing the impact of research on the resolution of the company's issues pertaining to the recruitment and selection of qualified workforce for the effective execution of organizational roles</td>
<td></td>
<td>C6 - A substantial allocation of responsibilities falls upon the HR professional</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C19 - The employee is required to respond to numerous demands, resulting in an inundation of his email inbox</td>
<td>C11 - To maintain the workforce budget, the assignments per employee are increased</td>
<td></td>
<td>C9 - The employee is required to respond to numerous demands, resulting in an inundation of his email inbox</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C10 - The job profile is multifunctional, progressively accumulating an increasing number of responsibilities.</td>
<td>C12 - UEFS stands as the sole point of reference for a public university within the city of Feira de Santana</td>
<td></td>
<td>C14 - The job profile is multifunctional, progressively accumulating an increasing number of responsibilities.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C15 - Absence of active engagement within the FIEB and CIFS</td>
<td></td>
<td></td>
<td>C17 - Because electronic digital communication results in a notably impersonal interaction, individuals within the corporate sector fail to recognize the significance of the research endeavor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CR2 - CETENS is recent and has yet to garner widespread societal recognition. This limited appeal is primarily attributed to the absence of traditional courses such as medicine and law</td>
<td></td>
<td></td>
<td>CR1 - To minimize operational costs and maximize profits</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CR3 - The lack of proactive engagement on the part of FIEB and CIFS in fostering a more active participation of the industrial sector.</td>
<td></td>
<td></td>
<td>CR3 - The lack of proactive engagement on the part of FIEB and CIFS in fostering a more active participation of the industrial sector.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CR4 - The method of communication via electronic resources is inadequate for individuals to perceive the significance and allocate the requisite time for a proper response to the questionnaire</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 2. The potential causes identified in the Ishikawa diagram organized by respective areas.
Source: Research Data.

A statistical analysis of the 6 areas of the Ishikawa Diagram revealed the following outcomes: labor (40%), method (24%), environment (20%), measurement (12%), machine
(4%), and materials (0%). It is evident that the majority of causative factors are concentrated in the labor and method areas, accounting for approximately 64%. These findings point towards management issues, such as improper allocation of work activities and a lack of methodologies for task execution. Following the identification of the four primary root causes, these were incorporated into the 5W2H tool to elucidate measures for the restriction or elimination of failures, with the aim of preventing or eliminating the root causes of the issue at hand.

To ensure that companies respond satisfactorily to electronic questionnaires, several actions are required, including: reevaluating the workload of HR employees within companies, developing outreach initiatives aimed at promoting awareness of UFRB/CETENS in the municipality of Feira de Santana and the Portal do Sertão region, informing FIEB and CIFS of the outdated status of companies' registrations in their databases, and conducting on-site visits to the 627 industries in Feira de Santana. The results of the 5W2H tool are presented in Table 3 below.

<table>
<thead>
<tr>
<th>5W2H</th>
<th>Root Cause</th>
<th>What?</th>
<th>Why?</th>
</tr>
</thead>
<tbody>
<tr>
<td>CR1</td>
<td>To minimize operational costs and maximize profits</td>
<td>Reassessing the accumulation of responsibilities among human resources personnel</td>
<td>To mitigate operational deficiencies such as non-responsiveness to the questionnaire, avoiding possible issues in the recruitment of new human resources for the company</td>
</tr>
<tr>
<td>CR2</td>
<td>CETENS is recent, and its academic programs are relatively nascent, lacking the societal appeal typically associated with institutions offering traditional disciplines such as medicine and law.</td>
<td>To undertake extension activities aimed at promoting the visibility of UFRB/CETENS within the municipality of Feira de Santana and the Portal do Sertão microregion</td>
<td>In order for UFRB/CETENS to gain recognition and achieve greater enrollment in its courses within the community of Feira de Santana and the Portal do Sertão, it is imperative to strategize and implement targeted initiatives</td>
</tr>
<tr>
<td>CR3</td>
<td>The failure of FIEB and CIFS to stimulate a more proactive engagement from the industrial sector</td>
<td>To convey to FIEB and CIFS the outdated status of company registrations within their respective databases</td>
<td>In order to handle the research questionnaire and maintain a connection that can elucidate the significance of the industry-university linkage, it is imperative</td>
</tr>
<tr>
<td>CR4</td>
<td>The electronic communication method is inadequate for individuals to perceive its significance and allocate the requisite time for a proper response to the questionnaire</td>
<td>On-site Visitation of 378 Industries and Businesses in Feira de Santana</td>
<td></td>
</tr>
</tbody>
</table>
Where | In the industrial context, within the realm of Human Resources | To present educational institutions the courses offered by UFRB/CETENS | In the industrial and corporate sectors within the realm of Human Resources
---|---|---|---
How? | Organizational reassessment of human resources professional duties to gauge available time for task execution | To enhance outreach activities by 20% with the aim of fostering closer ties between the university and the industrial sector of Feira de Santana and Portal do Sertão through the provision of short courses, lectures, events, projects, and conferences | Kindly request from its members the updating of their information | Introduce the CETENS, its offered courses, and the center's mission within the region. To apply and emphasize the significance of the questionnaire. Aim to achieve a 100% increase in the response rate for the upcoming year, specifically, from 20 to 60 responses
Who? | The head of human resources within the organizational context | Professors: we encourage the submission of additional extension projects, the organization of events, lectures, and conferences in this subject matter. Students: assistance in the implementation of these initiatives and actively participate in the events. | Industry and companies | Head of human resources in the organizations
When? | In the upcoming semester | In the upcoming semester | In the upcoming semester | In the upcoming semester
How much? | Zero | Zero | Zero | Zero

Table 3. The 5W2H Tool applied to root causes
Source: Research Data.

Planning with 5W2H tool plays a pivotal role in clarifying actions and structuring temporal engagement. Nonetheless, for continuous and incremental improvement to be efficacious, its execution via the PDCA cycle is imperative. It has been suggested that the planning derived from 5W2H should be incorporated into the "Plan" phase of the PDCA cycle, and the indicators for forthcoming cyclic actions are shown in Figure 4.

<table>
<thead>
<tr>
<th>PLAN</th>
<th>DO</th>
<th>CHECK</th>
<th>ACT</th>
</tr>
</thead>
<tbody>
<tr>
<td>To reevaluate the accumulation of responsibilities among human resources personnel</td>
<td>Organizational Reassessment of Human Resources Professional Responsibilities to Measure Available Time for Service Execution.</td>
<td>To reduce the responsibilities of the Human Resources professional by 20% and assess whether labor force idleness will ensue.</td>
<td>In the event of idle capacity, a 5% augmentation of responsibilities shall be implemented. Conversely, if the workload persists as burdensome, a 5% reduction in assignments shall be enacted.</td>
</tr>
</tbody>
</table>
To undertake extension activities aimed at promoting the visibility of UFRB/CETENS within the municipality of Feira de Santana and the Portal do Sertão region.

To prepare mini-courses for the dissemination of university knowledge to external institutions.

To increase extension activities by 20%, with the aim of fostering closer engagement between the university and the industrial sector of Feira de Santana and Portal do Sertão, through the implementation of mini-courses, lectures, events, projects, and conferences.

Ongoing efforts to continuously strengthen the reputation of UFRB/CETENS in the Feira de Santana and Portal do Sertão communities.

To inform FIEB and CIFS of the outdated status of company registrations within their respective databases.

To request from its members an update of the information in their records.

Update all active registrations within the database.

Persistently engage with the members until their records are successfully updated.

To introduce CETENS, the courses it offers, and the center's regional objectives.

Introducing CETENS, the courses it offers, and the center's regional objectives. Emphasizing the significance of the questionnaire. Aiming to augment the response rate by 100% for the upcoming year, specifically, from 20 to 60 responses.

Ongoing on-site visitation initiatives within industrial settings, aimed at enhancing the industry-university relationship.

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Table 4. The PDCA Cycle applied in the enhancement of future projects.
Source: Research Data.

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**Conclusion**

This research aimed to study and analyze, through an electronic questionnaire, the demand for undergraduate and postgraduate courses in Feira de Santana and the Portal do Sertão identity region. Many unforeseen barriers emerged along the way. The idea was born in a post-COVID-19 pandemic context, where companies, institutions, organizations, and various sectors of society were compelled to transition their activities to the virtual environment due to the required social distancing. Therefore, it was not expected that companies would exhibit resistance and neglect in engaging with the electronic survey, considering that the data obtained would serve to define the growth vectors of the CETENS/UFRB advanced campus while aiming to mitigate the long-term shortage of qualified workforce in the Portal do Sertão microregion. Despite the low number of responses, the questionnaire provided important data indicating a demand from the industry for a qualified workforce primarily in the fields of: I) undergraduate programs in Engineering or Management; and II) Postgraduate programs in the field of Management, particularly in the form of MBA specializations. In this regard, we also found, through the participants who responded to the electronic survey, the importance of seeking qualification in quick courses, such as basic Excel, or technical specialization in the use of specific tools within the industrial
sector. Also, the companies face difficulty in the process of tracking and hiring skilled workforce in the region. Some of the responses included: I) Lack of interest among young individuals in pursuing technical or vocational courses in the company's field of operation; and II) Candidates seeking specialization but unable to find organizations offering courses that meet their demands. Despite the low engagement of industries in responding to the survey during the first year of the project, an analysis of the demand based on the stratification and analysis of the 627 industries in Feira de Santana was conducted and indicated the need for 27 courses to meet the demand. However, the implementation of the aforementioned courses should undergo an analysis to determine which courses are already offered by other Public and Private Universities operating in the Portal do Sertão identity microregion to avoid redundancy in course offerings. Therefore, we recognize the importance of a continued effort by the project to fill this gap and strengthen CETENS/UFRB's role in the surrounding community. The result of this is the potential for improved quality of life for the community's residents alongside the sustainable development of the industry. The fruits of this project can be harvested in the form of new courses that meet industry needs and contribute to the absorption of students into the labor market.

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SEI BAHIA. *Território de Identidade Portal do Sertão*.


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