

MASTERS IN PRODUCTION ENGINEERING AT UFAM: CONTRIBUTIONS AND CHALLENGES FOR THE DEVELOPMENT OF PRODUCTION ENGINEERING IN THE STATE OF AMAZONAS

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ABSTRACT

The Professional Master's in Production Engineering at the Federal University of Amazonas has an important role in the technological, economic, and social development of the northern region. The Coordination for the Improvement of Higher Education Personnel seeks to evaluate the effectiveness and quality of the insertion of new masters in the academic environment and the impact on society of the knowledge obtained. In this sense, this article aims to analyze the contributions of the Professional Master's course in Production Engineering at UFAM to the development of the area and its future challenges. To achieve the proposed objective, quantitative and qualitative research was carried out, of a descriptive nature and based on data collected through a questionnaire and semi-structured interviews. The results of the research indicate that contributions are generated both for the graduates from the improvement in their professional situation, for the organizations through the researches implemented, and for the academy through terms of partnerships to train these professionals, thus contributing, to local and western Amazon economic and sustainable development.

Keywords: *professional master's degree; production engineering; graduate profile; productivity indicators*

1. INTRODUCTION

The emergence of Graduate Studies led to the development of stricto sensu courses, which are classified into masters and doctoral levels. The first stricto sensu courses were created in the early sixties when 38 courses were installed in Brazil (Santos & Azevedo, 2009).

Currently, Brazil has 4,656 graduate programs, 51% of which are distributed at the academic master's / doctorate level, 29% at the academic master's degree, 17% at the professional master's degree, 2% at the academic doctoral level, and 1% at the master's / doctoral level. professional (Capes, 2020).

Professional master's degrees are considered relatively new courses and are characterized by the training of qualified professionals in the most diverse areas of knowledge. The northern region has only 54 professional master's programs, which represents only 7% of the total professional master's degrees.

According to Capes data, Brazil has 130 programs in the area of Engineering III, classified in Mechanical Engineering, Production Engineering, Aerospace Engineering, and Naval and Ocean Engineering. Regarding Production Engineering, which currently corresponds to 54 graduate programs, 15 of which are offered through professional master's degrees, only one professional master's course is available in the northern region, through the state of Amazonas (Capes, 2020).

The professional master's degree in Production Engineering at UFAM, as it is located in an industrial region that houses the Manaus Industrial Pole, seeks to qualify professionals to work in various segments of the local and regional market, revealing its importance for economic development.

Capes seeks to verify the importance of the quality of the training of doctors and masters and the impact on society of the knowledge obtained in the context of the programs. Recently, there was a change in the Area Document for the period between the years 2017 to 2020, in which it determines the guidelines for the evaluation of postgraduate programs in Engineering III, where three requirements are established: program, training, and impact in society.

Previous studies such as the work of Mendes (2010), identified the contribution of the management tools of the professional master of production engineering at UFAM to the organization, academy, and professional life of the graduates. In the analysis of the data, it was obtained that 96% of the graduates informed that the professional situation improved, the organizations gained with researches that were implemented generating local and regional development and as for the academy contributed through partnerships to train professionals in Research, Development, and Innovation.

The study by Vasconcelos (2012) demonstrated the possibilities of productivity and quality gains for the Manaus Industrial Pole through the knowledge acquired by the graduates of the professional master's in production engineering at UFAM. According to the author, 40% of the graduates had a reward for salary improvement and there was an improvement in production time and efficiency, generating greater competitiveness for the company.

Thus, it is essential to evaluate the graduate in the job market, through the analysis of his professional performance with his training area, in which sector of society he is working, the impacts of his training on his economic and social condition, showing the destiny of these students and the added value to them with the conclusion of the course.

It is important to develop actions capable of detecting the value of professional master's courses in production engineering, as well as planning future actions aimed at maintaining the course. Therefore, the objective of this article was to analyze the contributions of the Professional Master's course in Production Engineering at UFAM to the development of the area and its future challenges.

This article is structured in six sections: a) introduction; b) literature review; c) research methodology; d) results and discussions; e) conclusions and finally f) bibliographic references used in the research.

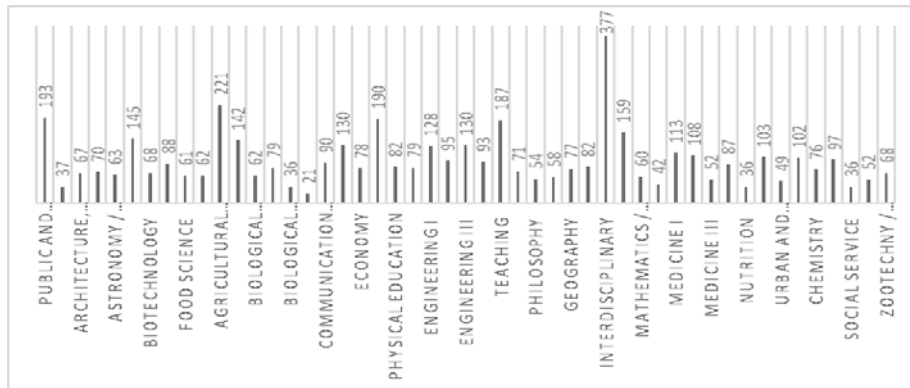
2. LITERATURE REVIEW

2.1. Professional Masters in Production Engineering in Brazil

Bittencourt, Viali, and Beltrame (2010) mention that in 1967, PUC-RJ was the pioneer in creating the first Master Program in Production Engineering in Brazil. That same year, the master's degree in Production Engineering at Coppe / UFRJ was also created, and in the 1970s, five more master's programs were instituted, including USP, UFF, UFPB, UFPE, and UFSM.

In 1980 there are no records of the creation of a post-graduate program or course in production engineering, however, since 1990 there has been a great increase in the number of master's programs (Bittencourt; Viali & Beltrame, 2010).

Graph 1 shows the number of graduate programs by area according to the 49 Capes assessment areas. Engineering III has 130 programs, the 9th largest in the number of programs. Graduate programs in Engineering III are offered through Academic or Professional Master's and Academic Doctorate courses.

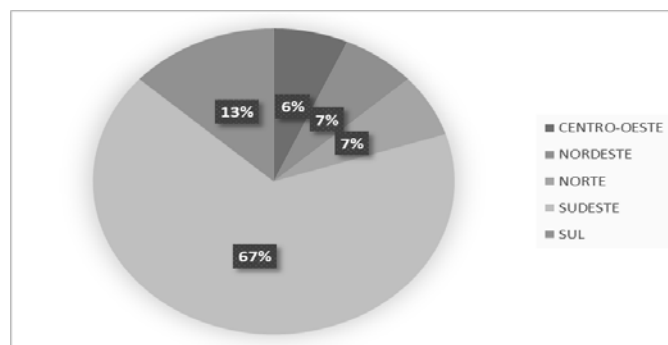


Graph 1: Number of Programs by Evaluation Area
 Source: Prepared by the authors (2020).

Engineering III programs are divided into Mechanical Engineering, Production Engineering, Aerospace Engineering, and Naval and Ocean Engineering. The Mechanical Engineering area has the highest concentration with 67 programs, followed by the Production Engineering area with 54, demonstrating that production engineering has a large portion of programs. The area of Aerospace Engineering and Naval and Ocean Engineering have, respectively, 5 and 4 programs.

Production Engineering has 54 graduate programs, offered through 15 Academic Masters, 15 Professional Masters, 23 Academic Masters and Academic Doctorates and 1 Professional Master and Professional Doctorate.

Graph 2 shows the distribution by region of Professional Masters in Production Engineering, in which more than 60% of the programs are concentrated in the southeastern region, demonstrating regional asymmetry. The south region has 13%, then the northeast and the north region with 7% each and the central-west region with 6%.



Graph 2: Distribution of Professional Masters in Production Engineering by Region of Brazil
 Source: Prepared by the authors (2020).

Table 1 describes the quality of the Professional Master's programs in Production Engineering, as a result of the 2017 four-year evaluation. Of the institutions that offer

professional master's in Production Engineering, two received grade A, 9 institutions received grade 3 and only 3 institutions received note 4. No professional master's program reached grades 6 and 7, considered international by Capes.

Table 1: Distribution of grades of Professional Masters in Production Engineering

EDUCATIONAL INSTITUTION	NOTE
GOIAS FEDERAL UNIVERSITY	A
FEDERAL UNIVERSITY OF SÃO CARLOS	A
PAULA SOUZA STATE TECHNOLOGICAL EDUCATION CENTER	3
NATIONAL INSTITUTE OF METROLOGY, STANDARDIZATION AND INDUSTRIAL QUALITY	3
CÂNDIDO MENDES UNIVERSITY	3
UNIVERSITY OF ARARAQUARA	3
UNIVERSITY OF CAXIAS DO SUL	3
PAULISTA STATE UNIVERSITY JÚLIO DE MESQUITA FILHO	3
FEDERAL UNIVERSITY OF ITAJUBÁ	3
FEDERAL UNIVERSITY OF AMAZONAS	3
FEDERAL FLUMINENSE UNIVERSITY	3
PONTIFICAL CATHOLIC UNIVERSITY OF RIO DE JANEIRO	4
FEDERAL UNIVERSITY OF BAHIA	4
FEDERAL UNIVERSITY OF RIO GRANDE DO SUL	4

Source: Prepared by the authors (2020).

3. RESEARCH METHODOLOGY

To meet the objective proposed in the study, this research is exploratory and descriptive. Exploratory research seeks to provide information to deepen knowledge about an object, fact, or phenomenon, to allow greater familiarity with the problem, making it clearer (Malhotra, 2012). Descriptive research, on the other hand, aims to observe, record, and analyze the facts, without going into the merits of the contents. It describes certain attributes of a population or phenomenon or the establishment of relationships between variables (Perovano, 2014).

As for the approach, the research strategy was qualitative and quantitative. Creswell (2014) defines that qualitative research starts with hypotheses and the use of structures that inform the study of research problems, formed by practices that make the world visible from an interpretive and naturalistic approach.

In quantitative research, the use of quantification is characterized, both through the collection of information and the treatment of it, which is worth translating into numbers, opinions, and information to classify and analyze them. In the development of the research, it is necessary to formulate hypotheses and classify the relationship between the variables to guarantee the accuracy of the results, avoiding contradictions in the analysis and interpretation process (Richardson, 2012; Prodanov & Freitas, 2013).

As for technical procedures, the research was classified as bibliographic, documentary, and field research. Bibliographic research is related to the search for records already available, resulting from previous research, covering printed material, through books, magazines, newspapers, theses, dissertations, in addition to including other types of sources, such as discs, CDs, and electronic media, however, always observing the reliability of the means of research (Gil, 2010; Severino, 2016).

While the bibliographic research essentially uses the contributions of several authors on a certain topic, the documentary research uses materials that have not yet had an analytical treatment, or that can still be elaborated according to the research objectives (Prodanov & Freitas, 2013; Severino, 2016).

Field research is based on the observation of facts and phenomena that occur voluntarily, the collection of data related to them, and the registration of variables that we assume to be important, to examine them (Marconi & Lakatos, 2011; Prodanov & Freitas, 2013).

In this article, both the questionnaire and the interview were used to obtain a survey of documentary data from the UFAM master's program in production engineering from 2012 to 2018, to inventory the information that was organized and categorized in tables, graphs, and tables to present the consolidated results.

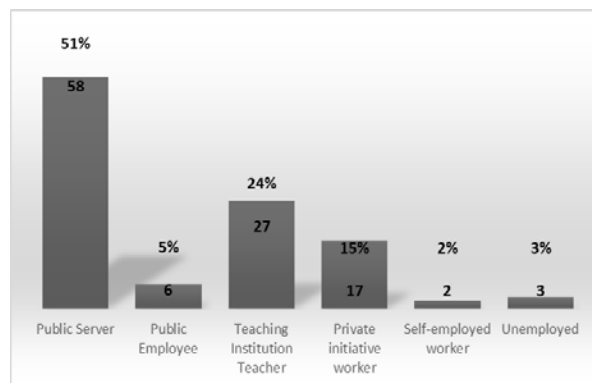
4. RESULTS AND DISCUSSIONS

Based on the data collected through questionnaires, a 50% sample was obtained, which corresponds to 113 respondents out of a total of 226 graduates from 2012 to 2018. The largest participation in the research were those who completed the year 2017 with a total of 28 respondents, which corresponds to 25% of graduates. As for the gender, 57% are male, 42% female, and those who preferred not to define it was 1%. Regarding the time of completion of the course, 67% completed in 2 years, which is the time stipulated by the program, 17% in 3 years, 7% in 4 years, 6% in 1 year, and 2% in 5 years.

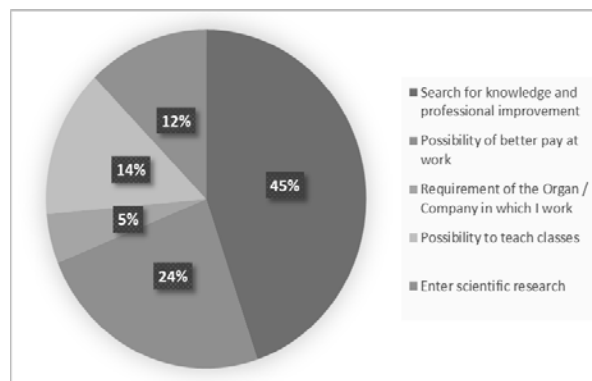
Regarding the age of graduates, 37% are over 50 years old, 32% between 39 and 49 years old, 30% aged between 28 and 38 years old, and 1% those who did not want to inform. The greatest representation is of graduates over 50 years old, which points out that many of them started the course late, but managed to complete the search for a professional qualification.

Graph 3 informs the graduates' occupation, with 58 civil servants, 6 civil servants, 27 teachers from educational institutions, 17 private-sector workers, 2 self-employed workers and only 3 are unemployed. The data point mostly to public servants, being the result of terms of partnerships between UFAM and governmental organizations.

Regarding the motivation of graduates to choose the course, about 45% opted for the choice of the master's degree for the search for knowledge and professional improvement, 24% for the possibility of better remuneration at work, 14% for the possibility of teaching classes, 12% for the possibility to enter scientific research and only 5% as required by the agency/company in which you work, as shown in Graph 4.



Graph 3: Occupation
 Source: Prepared by the authors (2020).



Graph 4: Motivation of Graduates in the Course
 Source: Prepared by the authors (2020).

The search for knowledge and professional improvement is evidenced through the fragments of a discourse of S2, S3, S4, and S6.

- (S2) I was always interested in studying and it was a dream to travel the path of education, interest in continuing to study beyond the lato sensu specialization, through a master's degree, and then aiming to pursue a doctorate.

- (S3) The search for knowledge, because we live surrounded by industries, we have more than 800 companies in the Industrial Pole of Manaus.
- (S4) I had a lot of that biomechanical view of work, of the body itself, but I didn't have the process as a whole, it was a limitation that I had.
- (S6) I was already looking for a line of studies that could somehow be innovative and have an evolution in my professional career.

The research shows that most of the graduates started the course thinking about expanding their knowledge, improving their management capacity, mainly because there is the Manaus Industrial Pole, in which many of them compete for a job.

Concerning the support of the program about the course information, the majority responded positively that they were oriented about the requirements of the program. The speech fragments of S2, S3, S4, S5, S6, and S7 reveal this support.

- (S2) Program coordination was always very helpful when we needed it.
- (S3) Yes, it was always supported by the program secretary.
- (S4) Yes, we had a meeting before starting the master's degree with the whole class.
- (S5) Yes, in fact, we had really good publicity about it.
- (S6) Yes, information always came to us.
- (S7) Yes, we did, the staff gave a lot of support mainly because they charged.

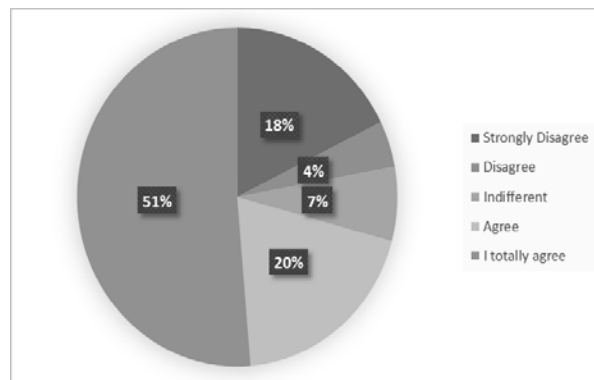
Regarding contact with their advisor, they reported that they had a very good and caring relationship on the part of the advisor, without the need to change advisor during the course, as can be seen in the speech fragments of S2, S3, S5, and S6.

- (S2) When I needed it, my advisor always received me.
- (S3) She was always open to replying to my messages and making appointments.
- (S5) Very easy, my advisor helped me a lot and was always available.
- (S6) Very easy and available communication, I had no difficulty.

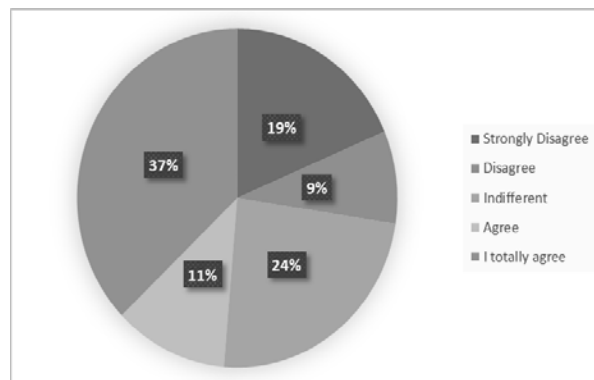
Graph 5 shows the perception of the graduates regarding their career development after joining and completing the course. Of the survey sample, 51% responded that they totally agree, 20% agree, 7% are indifferent, only 4% disagreed and 18% totally disagree. The results

indicate that for the majority the master's degree had provided them with a positive change in their work, which points to the relevance that the knowledge generated can provide.

Regarding the implementation and practical application of the research carried out in the company that works, 37% answered that they totally agree, 11% agree, 24% are indifferent, 9% disagree and 19% totally disagree, as shown in Graph 6. It is verified that the graduates took the practice to the work environment and through the acquired knowledge they managed to implant satisfactory results for the organizations.



Graph 5: Salary Reward or Improvement
 Source: Prepared by the authors (2020).



Graph 6: Dissertation Methodology in the Company
 Source: Prepared by the authors (2020).

After the conclusion of the course, the graduates had a change of posture concerning the solutions to solve problems and even to propose changes for improvement in which they can contribute to the company's operational and financial results. As can be seen in the speech fragments of S4 and S6. On the other hand, the speeches of S1, S2, S3, and S7 illustrate that there was no such evolution in the career.

- (S1) No, I'm in the public sector, so only if I could get a position of trust.

- (S2) In municipal public management, the criterion is largely political, so we have this criticism from the public agency.
- (S3) I remained at the same level because in this company it is difficult for you to climb.
- (S4) Yes, until then I didn't see myself working in engineering because I graduated as a physiotherapist, I had a very assistentialist view.
- (S6) For the consolidation of the results that I presented, the way I modified the company since 2018 I became a director.
- (S7) The company where I worked was sold and the new company that bought it had a different culture, it was reducing the staff.

The following speech fragments corroborate with the results of the quantitative research, confirming the implementation of the methodology in the work environment of all respondents: S1, S2, S3, S4, S5, S6, and S7.

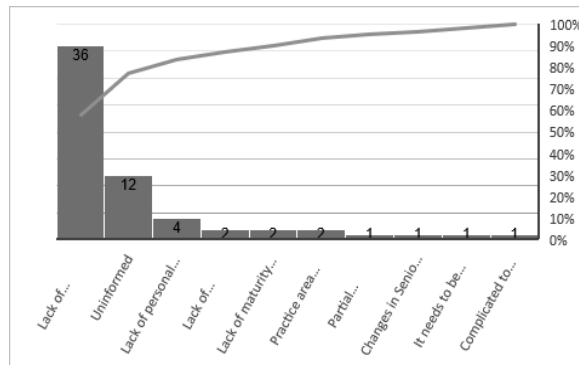
- (S1) Yes, my project was focused on analyzing the patent potential of monographs, so we found that the process could really be improved.
- (S2) Yes, where I work, knowledge was transmitted orally and when people moved, knowledge was lost.
- (S3) It was presented to the institution the expansion of the academy to attend physically disabled because Manaus has more than 30% of people with disabilities.
- (S4) Yes, my work was about Burnout syndrome within the company and I see the best way to be able to optimize this service.
- (S5) Yes, it became a service that we put on the market as a product that was called absenteeism management.
- (S6) Yes, I used the use of production engineering tools in information technology projects in retail companies.
- (S7) The product that I managed to generate in the master's degree served to improve the company's processes since it was all done manually and with that, it was automated.

Graph 7 presents the reasons for not implementing improvements resulting from the research. Of the total respondents, 36 indicate that it was the lack of institutional interest, 12

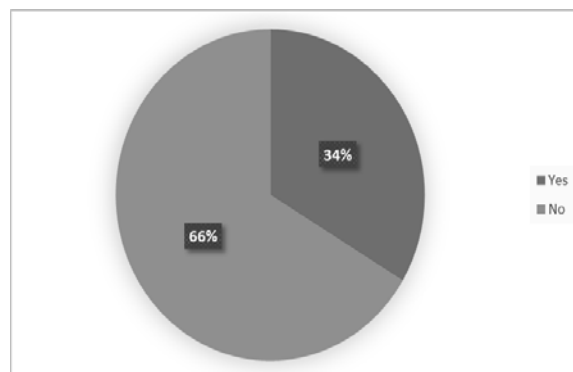
did not want to inform, 4 responded to the lack of personal interest, 2 responded to the lack of opportunity, 2 responded to the lack of maturity at work, 1 informed the partial implementation, 1 informed due to the changes in senior management, 1 informed that it needs to be discussed by management, 2 responded that the area of activity was different from the area chosen in the dissertation and 1 informed that it was complicated to implement due to decision making in the industrial sector.

Due to the lack of institutional interest, opportunity, recognition, salary improvement, among others, some masters are unable to put into practice the benefits that could be generated through the technical knowledge of production engineering.

As for professional advancement to management positions, 66% reported that they are not exercising managerial functions and 34% are exercising managerial functions, as shown in Graph 8. With this result, it is observed that not all organizations are available to capture all the intellectual capital of its employees, which demonstrates the lack of opportunity that many graduates feel.



Graph 7: Reason for Not Implementing in the Company
 Source: Prepared by the authors (2020).



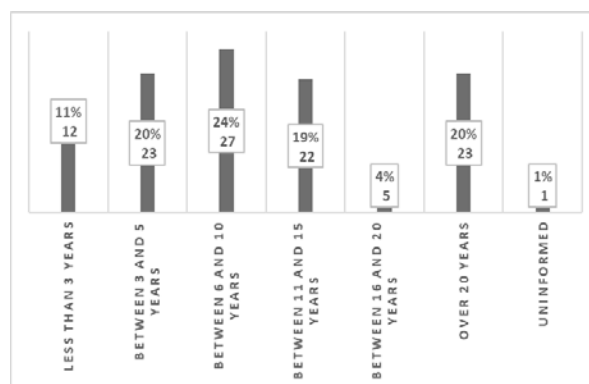
Graph 8: Occupies Managerial Position
 Source: Prepared by the authors (2020).

The inability to assume managerial positions, especially when it is a public institution, in which it depends on an indication to assume, is evidenced in the fragments of speeches by S1, S3, and S7.

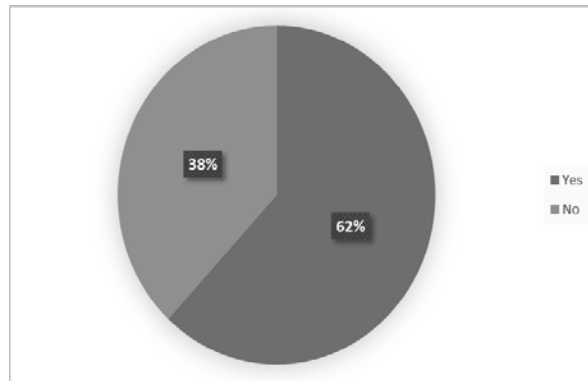
- (S1) No, at most it was covering the manager's vacation.
- (S3) No, I believe that everything is too slow to evolve, as I was already working at a higher level and the manager is already in a more political position where I work.
- (S7) In the public service where I am, I don't have many opportunities.

Graph 9 shows the time the graduates have in their occupation, with 12 reporting being less than 3 years old, 23 between 3 and 5 years old, 27 between 6 and 10 years old, 22 between 11 and 15 years old, 5 between 16 and 20 years old years, 23 to more than 20 years and 1 did not report. There is a greater number among those who exercise their occupation between 6 and 10 years, the longer the graduate stays in the same company, it indicates that they are professionals committed to their work and that seek improvement to perform their activities better.

Graph 10 shows the graduates who work or were working in the area in which they took the master's degree, 62% reported yes and 38% no. Graduates are increasingly seeking to improve their knowledge, even those from different areas. The master's degree provides a broader view of management and, thus, they can implement improvements in their work environment, providing financial results.



Graph 9: Occupation time
 Source: Prepared by the authors (2020).



Graph 10: Worked in the Course Area
 Source: Prepared by the authors (2020).

However, it appears from the interviewees that they do not work in the area in which they took the course, there are many with degrees that are not production engineers, but who managed to use the master's degree to improve their management vision within the company. The fragments of speeches by S1, S3, S4, S5, and S7 reveal that they work in different areas of production engineering, but managed to adapt their work environment after master training.

- (S1) When I joined the company I went to the financial area, with the master's degree I was able to bring mainly the issue of procedural analysis and procedures.
- (S3) I work with sales and would like to work in this area of production time, the product, and project issues.
- (S4) I am a physical therapist at work and the master's degree allowed me to adapt my vision that was more related to the mechanics of the body.
- (S5) If I go for what is the goal of production engineering, I can say yes, because I have to analyze the process and I have to improve them.
- (S7) I practice more in practice because everything we work on today with processes, mapping, and others is all about production engineering.

Regarding the possibility of working within their training area, it was evidenced that yes, they managed to consolidate the production engineering tools in the management of the company's services and processes, according to the speech fragments of S4, S5, S6, and S7, except for the findings verified in the fragments of speeches by S1 and S2, which state that they do not have the opportunity, either due to the company's lack of interest in taking advantage of it or because of the lack of interest from the management.

- (S1) In my case there is no valuation in terms of the master's degree, the company does not direct the employee for having a master's degree.
- (S2) I don't have the opportunity to apply the knowledge, even with a master's degree.
- (S4) Yes, I am a physical therapist at work and the master's degree helped to broaden my vision.
- (S5) I already worked as a manager in my company, I was able to contribute better to the management of the processes I develop.
- (S6) Through production engineering, I was able to consolidate technology tools and production engineering tools to manage processes.
- (S7) I have a degree in administration, but the activities I do are almost all focused on production engineering, I can contribute much more now.

Regarding the change of job or the beginning of a new job, the results of the interviews indicate that the change was due to the search for better financial benefits or the opportunity to develop new activities. The speech fragments of S1, S2, and S4 demonstrate this search for a job that brings your personal satisfaction.

- (S1) I changed mainly due to financial issues and workload.
- (S2) The change was personal dissatisfaction due to a political issue, we propose to do a study within the secretariat, but we have no autonomy.
- (S4) I changed my job to look for other opportunities.

As for the relationship between the master of production engineering at UFAM with the development of the area in the State of Amazonas and its future challenges, they emphasized that there is a lack of communication between the Industrial Pole and the academy, as companies are looking for professionals from outside the state while the academy is training these people. Production engineering can be applied to both public and private institutions, with the possibility of applying it to improve their procedures. The fragments of speeches by all interviewees report this lack of use by these professionals.

- (S1) Production engineering would make it possible for professionals from different areas to approach management, adding value with the formation of a master.

- (S2) I think it has a lot to contribute, the public service would be modernized according to the knowledge of production engineering.
- (S3) The area should have more autonomy since most large companies receive their drawings from outside, that is, from the headquarters, we end up being just executors.
- (S4) It is still a very focused vision for the industrial district and not so much for other areas of work, thus being able to show the objectives of the course.
- (S5) Companies have to provide the necessary support to achieve the application of engineering, we have good researchers here and unfortunately, it is not valued.
- (S6) I see it is certain anguish due to lack of market, I speculate that it is not using the real resource at its disposal.
- (S7) We have a huge laboratory that is our Manaus Industrial Pole, but it just seems to me that there is a distance between academia and industry.

Also, the graduates reported what were the main challenges encountered and the main achievements and for many of them, the main challenge was to assimilate the content of the course subjects because they are not in the area of production engineering. And about the main achievement, the knowledge acquired was evidenced, so that they could have a managerial view of how to apply the production engineering tools and their contribution to society. As evidenced in the speech fragments of S2, S4, and S6.

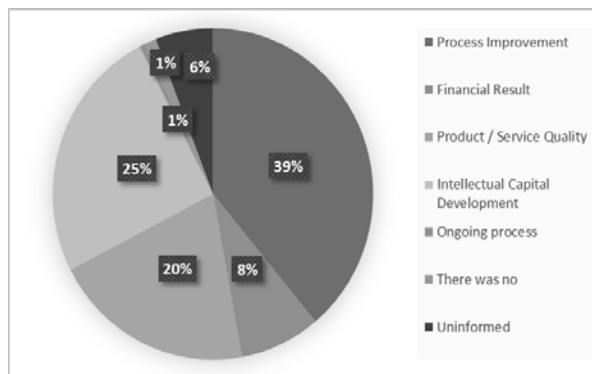
- (S2) The main challenge was to relate the knowledge that we learn in the master of production engineering. The achievement was the modernization of management and the gain from the knowledge acquired.
- (S4) I had to read articles that were not what I was used to seeing. My accomplishment was to understand engineering vision.
- (S6) The challenge in my case for not being from the area was to study the whole history of that topic. The achievement is to deliver work that works and that has resulted.

Graph 11 shows the contribution of research to the organization, with 39% reporting that the process has improved, 25% was the development of intellectual capital, 20% was the quality of the product or service, 8% was the financial result, 6% did not report and 1% reported that the process was in progress or that there was none. The results of the study indicate that

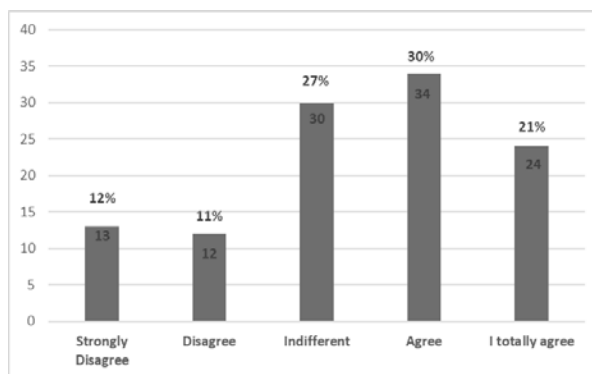
the master's degree has contributed to the development of the region, adding the necessary technical knowledge for these professionals, since they were able to implement improvements in their organization's routines.

Regarding the substantial changes that the master's degree provided in the work environment, 24 responded that they totally agree, 34 responded that they agree, 30 responded that they are indifferent, 12 responded that they disagree and 12 responded that they totally disagree, as shown in Graph 12.

The graduates who had the opportunity to apply the research in their work environment and who had free access to data collection managed to implant the results in the organization contributing to the company's performance.



Graph 11: Contribution of the Dissertation
 Source: Prepared by the authors (2020).



Graph 12: Substantial Changes at Work
 Source: Prepared by the authors (2020).

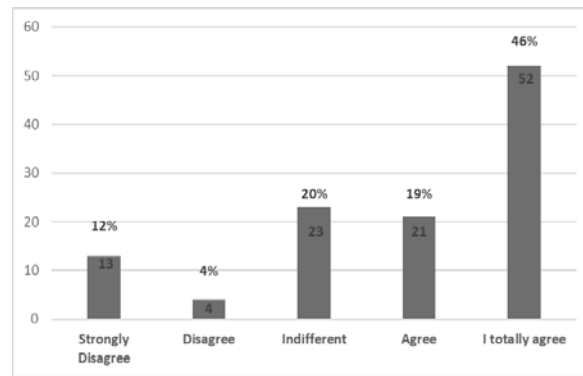
The fragments of speeches by S2, S4, S5, S6, and S7, corroborate with the findings of quantitative research since they show the application of research in their work environment. Also, the fragments point out that there were gains in productivity and efficiency, causing the organization of the company's routines to be organized, providing a healthy work environment for employees, and even reducing costs.

- (S2) It had an impact on improving administrative routines.
- (S4) We were able to improve the workplace of my company, adapting these, and proposing alternatives.
- (S5) We generated a product and from it, we could generate programs within the company so that it could reduce or even eliminate the causes of diseases.
- (S6) It was applied and had an efficiency gain and cost reduction.
- (S7) We applied software and the company was impacted by the gain in productivity and time.

As for the generation of products from the master's thesis, 52 responded that they totally agree, 21 responded that they agree, 23 are indifferent, 4 disagree and 13 responded that they totally disagree, as shown in Graph 13. The research showed that the studies carried out through the dissertations are being implemented in companies, therefore, they are works that are contributing to the development of production engineering in the state of Amazonas.

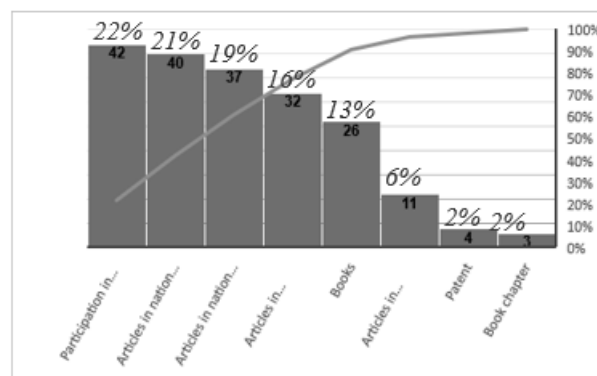
Graph 14 shows the types of publications made by graduates, the research shows that 22% participated in events, 21% published articles in a national congress, 19% published articles in a national journal, 16% published articles in an international journal, 13% published in 6% published articles in an international congress, 2% published in book chapters and 2% in patents.

It is observed that the graduates sought to participate in events during the course, with their largest participation in the national congress, as for publication in indexed journals, the greatest concentration was in national journals. Students' publications in international congresses and journals in which there is greater visibility before the scientific community should be encouraged. Scientific publications are essential in assessing the impacts of the program's products and are evaluation factors by Capes.



Graph 13: Product

Source: Prepared by the authors (2020).



Graph 14: Types of Publication

Source: Prepared by the authors (2020).

Regarding the incentive on the part of the supervisor and teachers of the program in scientific publications, 87% reported having been encouraged to publish and 13% reported that they were not encouraged.

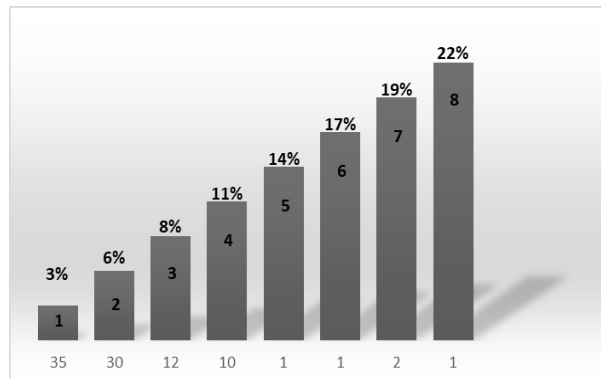
The fragments of speeches by S2, S3, and S5 show that despite the encouragement, many responded that they only published the article as required by the program, as they reported that due to their work they did not have time to dedicate themselves to the articles.

- (S2) As a requirement of the program I published an article in a magazine, the production time was short due to work.
- (S3) I managed to participate in a symposium in the area that took place at Ufam and published the article that is mandatory for the program.
- (S5) I published an article because I didn't have time.

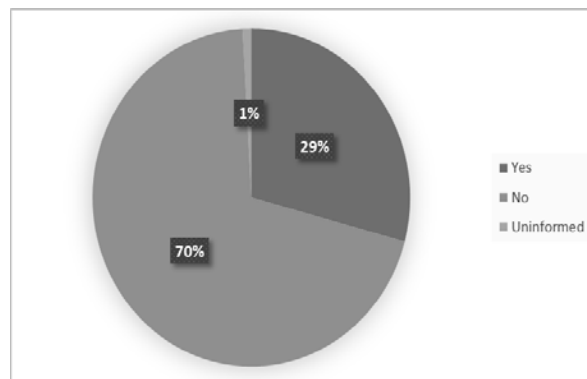
Graph 15 shows the number of publications made by graduates during the course, 35 reported having published only 1 article, 30 published 2 articles, 12 published 3 articles, 10 published 4 articles, 1 published 5 articles, 1 published 6 articles, 2 published 7 articles and 1

published 8 articles. It must be taken into account that some scientific journals take a long time to answer about approval.

Graph 16 shows publications after the master's degree, 29% reported that they continue to publish, 70% are not publishing and 1% did not report. Most claim that one of the reasons is the lack of time to write, due to other professional activities.



Graph 15: Number of Publications
 Source: Prepared by the authors (2020).



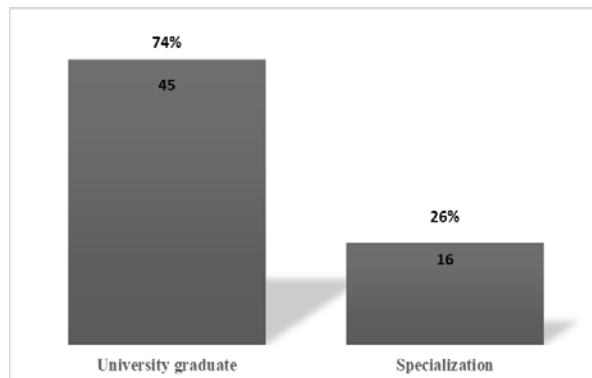
Graph 16: Currently Publishing
 Source: Prepared by the authors (2020).

The lack of time in being able to reconcile work and publication of articles informed by the graduates can be confirmed through the fragments of speeches by S1, S2, and S6.

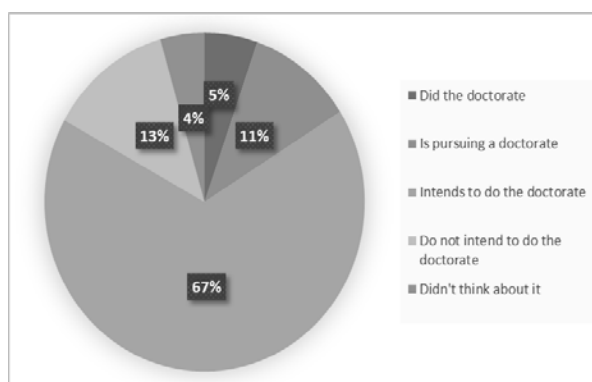
- (S1) No, especially when it comes to reconciling work and academic life.
- (S2) No, I never produced anything again, there is no time, I think about going back now.
- (S6) I stopped for lack of time.

When asked about working as a teacher, 54% informed that they work, and 46% that they do not. Of the graduates who are acting as teachers, 45 responded to teach for graduation and 16 responded to specialization, as shown in Graph 17. The results of the research indicate that the graduates were able to develop academic activities in educational institutions, contributing to the intellectual capital of the students of these institutions and spreading the area of production engineering in the state of Amazonas.

About the doctorate in the area, Graph 18 illustrates the choice of graduates, with 67% intending to pursue a doctorate, 13% not intending to do a doctorate, 4% have not thought about the subject, 5% have already done a doctorate, and 11% pursuing a doctorate. It appears that the graduates feel the need to continue improving their knowledge.



Graph 17: Course that Teaches
 Source: Prepared by the authors (2020).



Graph 18: Choice for the Doctorate
 Source: Prepared by the authors (2020).

Only the fragments of speeches from S3 and S4 were confirmed as a teacher. The fragments of speeches by S2 and S7 corroborate the result of not acting as a teacher, as they reported that there were many requirements in the selection and many requested a doctorate.

However, the quantitative results reveal the importance of the program for the training of qualified labor to work in the area of education.

- (S2) I have tried, but I did not proceed because the institutions were looking for stricter criteria, they always asked for a doctorate, I did not have the required degree.
- (S3) For higher education, I minister since I graduated, but as an instructor and teacher I have been working for a long time.
- (S4) I continue to work as a teacher, teach production engineering classes for graduate school.
- (S7) I am interested in acting, but even having a master's degree I do not get this opportunity, there are always many demands, and when they open there are few vacancies.

The intention of wanting to do a doctorate in the area is indicated in the fragments of speeches by S1, S2, S4, S5, and S6. The opportunity to apply for a doctorate is verified by the majority of graduates, and many of them know that they need scientific publications to strengthen their academic production and thus apply for a position for a doctorate.

- (S1) Yes, but to pass I will have to produce more scientifically.
- (S2) Yes, if a doctoral opportunity arises.
- (S4) I have already looked at the possibility for my area of training and in production engineering.
- (S5) I intend to do a doctorate and if the opportunity arose to do it in the area of production engineering I would do.
- (S6) I intend to do the doctorate.

As for the suggestions for improvement for the program, it was informed that they needed a greater incentive to publish articles, to stimulate interest in writing and pointed out the lack of partnerships with private institutions so that they could finance events external to students, according to speech fragments from S1, S2, S4, S5, and S7.

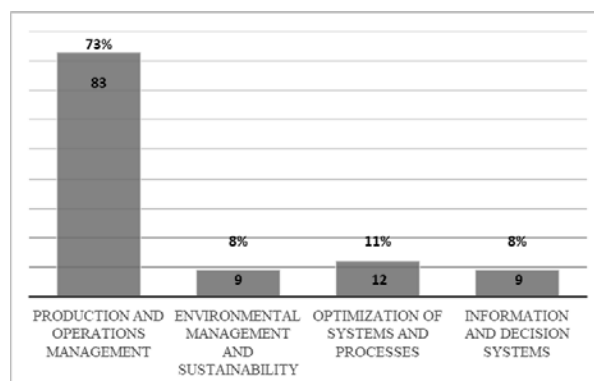
- (S1) The program needs to encourage the production of articles and events, establish partnerships with the private sector to finance students at events.
- (S2) Offer more vacancies in the selections, seeking partnership for Ufam.

- (S4) I think having the delivery of scientific articles, maybe even more than one.
- (S5) Deepen the methodology of higher education, focus to help students become researchers.
- (S7) It is the incentive to publish, all matters should require an article.

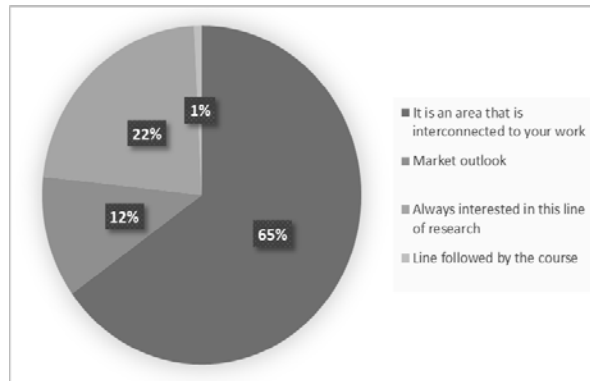
Graph 19 shows the distribution of graduates according to the research line, it is observed that the most demanded research line was the Production and Operations Management line with 73%. The research line Optimization of Systems and Processes presented 11%, followed by the research lines Environmental Management and Sustainability and Information and Decision Systems with 8% each. The Production and Operations Management line of research is the one that demands the greatest amount of work, which can be explained by the greater number of teachers in the program who work with this line of research.

Regarding the choices of the research lines, 65% reported that it is an area that is interconnected to their work environment, 22% reported that they were always interested in this line of research, 12% chose it because of the market perspectives and 1% chose it because line followed by the course, as shown in Graph 20.

The choice of the research line demonstrates the graduates' concern to seek new knowledge in the face of companies installed in the Manaus Industrial Pole and for public bodies, in a way that brings new strategic guidelines to innovate and update.



Graph 19: Research Line
 Source: Prepared by the authors (2020).

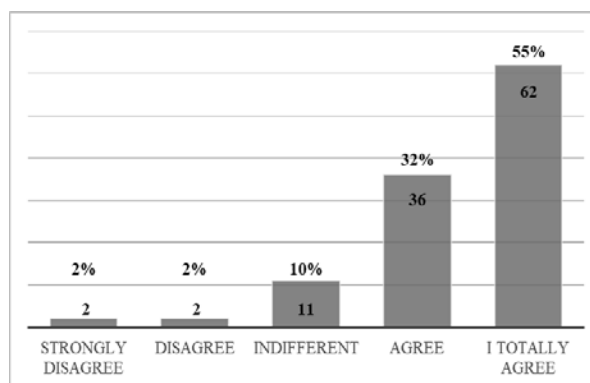


Graph 20: Research Line Motivation

Source: Prepared by the authors (2020).

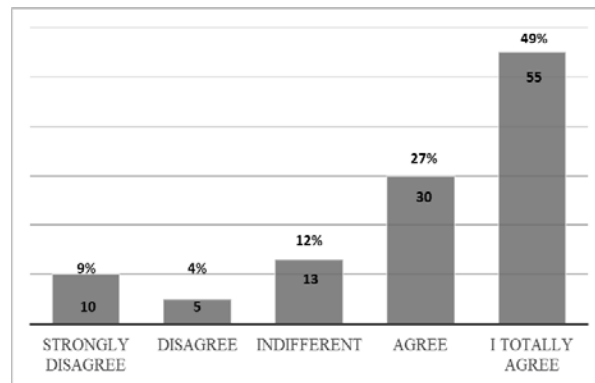
Graph 21 shows the graduates' perception of the program's contributions to improving their professional performance. Most respondents, that is, 62 graduates responded that they totally agree, 36 agree, 11 are indifferent, 2 disagree and 2 disagree completely. The result demonstrates that the majority, 55% agree that the master's degree allowed them to perform their activities more efficiently.

Graph 22 shows the graduates' response if the institution in which they work or worked was interested in training their employees, 55 responded that they totally agree, 30 agree, 13 are indifferent, 5 disagree and 10 disagree completely. Most graduates state that the institution needs trained professionals to solve problems or implement new management models.



Graph 21: Professional Performance

Source: Prepared by the authors (2020).



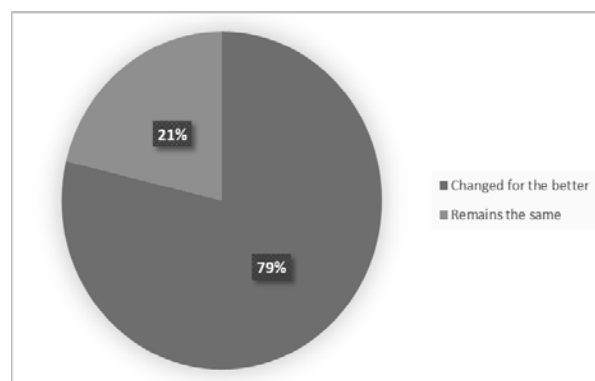
Graph 22: Interest of the Training Institution

Source: Prepared by the authors (2020).

Graph 23 shows the graduate's situation after completing the course, 79% said it has changed for the better and 21% remains in the same situation. The filling of more demanding qualification vacancies, especially in the industrial sector, is often done through professionals from other regions and even from other countries. Therefore, companies need to value the potential and knowledge of their employees.

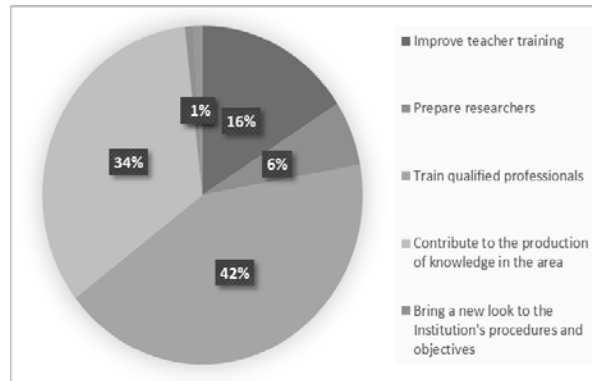
Regarding the objectives achieved by the program, for 42% it was to train qualified professionals, 34% was the contribution to the production of knowledge in the area, 16% was to improve the training of teachers, 6% was to prepare researchers, 1% was to bring a new look for the institution's procedures and objectives and 1% reported that all objectives are listed, as shown in Graph 24.

Given the competitive scenario in which companies find themselves, the search for the training of qualified professionals in production engineering is extremely important, as through it contributions are made both for graduates from the improvement in their professional situation, for organizations through research, and to the academy through terms of partnerships to train professionals.



Graph 23: Situation after the Course

Source: Prepared by the authors (2020).



Graph 24: Objectives Achieved by the Course
 Source: Prepared by the authors (2020).

5. CONCLUSIONS

The results of the study demonstrate that the master's degree in production engineering at UFAM provided the training of professionals in line with the needs of the region, provided a change in the posture of the graduates concerning problem solving and even proposing improvements, in which they could contribute with the operational and financial result of the companies installed in the Industrial Pole of Manaus and Public Organizations.

Although the survey identified that graduates sought to participate in events at national congresses, as well as the publication of their work and research in national journals, there was little participation in international journals and events. In this way, the program has remained, over the years, with the CAPES concept 3. In this regard, the program has weaknesses in terms of qualification and the number of scientific productions carried out by both students and teachers, a fundamental requirement to raise a superior concept with CAPES.

The professional master's program in production engineering at UFAM has contributed to the training of professionals with technical knowledge to develop activities that can implement improvements in the routines of their organization, favoring the development of the region and aggregating academic activities in educational institutions, cooperating for the intellectual capital of the students of these institutions and in the dissemination of the production engineering area in the state of Amazonas.

Also, contributions are generated both for graduates from the improvement in their professional situation, for organizations through the research implemented and that generate local and regional development, and for the academy through terms of partnerships to train these professionals.

The program has weaknesses in terms of qualification and the number of scientific productions carried out by both students and teachers, a fundamental requirement to raise a superior concept with CAPES.

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