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Technological Innovation through "Spin-off" of Biotechnology in the Amazon in Science and Technology Institutions-ICT and its Journey to the Market

A Inovação Tecnológica por meio de "Spin-off" de Biotecnologia na Amazônia em Instituições de Ciência e Tecnologia-ICT e sua Jornada ao Mercado

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RESUMO

O objetivo foi contribuir com a formação de spin-offs no segmento de biotecnologia na Amazônia, em ICTs, envolvidas com inovação, transferência tecnologia para o mercado, oriundo de empreendimentos acadêmicos bem-sucedidos. Optou-se pela metodologia exploratória, bibliográfico, documental e com abordagem qualitativa a partir da teoria da inovação que identificam a trajetória das spin-offs, com competências para o desenvolvimento de produtos e processos inovadores em sua jornada mercadológica. Conclui-se que em inovação biotecnológica na Amazônia, é preciso unir esforços do setor privado, governo e spin-offs de ICTs. Estas últimas podem contribuir com profissionais capacitados e laboratórios para PD&I, na direção de responder às necessidades de desenvolvimento socioeconômico sustentável, por meio das oportunidades para spin-off de biotecnologia como instrumento de transferência de tecnologia das ICTs objetivando práticas de implementação as novas tecnologias de acesso ao mercado.

Palavras-chave Inovação; *Spin-off*; ICTs; Mercado.

ABSTRACT

The objective was to contribute to the formation of spin-offs in the biotechnology segment in the Amazon, in ICTs, involved with innovation, technology transfer to the market, derived from successful academic ventures. We opted for the exploratory methodology, bibliographic, documentary and with qualitative approach from the theory of innovation that identify the trajectory of the spin-offs, with competencies for the development of innovative products and processes in their market journey. Concluded that in biotechnological innovation in the Amazon, it is necessary to join efforts of the private sector, government, and spin-offs of ICTs. The latter can contribute to skilled professionals and laboratories for R&I, to respond to the needs of sustainable socioeconomic development, through opportunities for biotechnology spin-off as an instrument of technology transfer of ICTs aiming at implementing innovative technologies for market access.

Keywords: Innovation*; Spin-off*; ICTs; Market

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INTRODUCTION

Currently, the period is expected in relation to the future of the areas of Science, Technology, and Innovation in Brazil. A policy design for the sector, combined with the forecast of large investments in research and development, makes growing the hope of making innovation a powerful tool for the insertion of the country in the global economy and to generate competitive advantage to companies before their competitors in the market. Extremely important theme that permeates the academic, business and government environment. However, innovation is not a linear phenomenon, where massive investments in research and development ensure the emergence of innovation, on the contrary it is a nonlinear, interactive, dynamic and social process, characteristics that bring complexity to the process. Therefore, it is a phenomenon permeated by uncertainty and risk and endogenous to economic activity (CASSIOLATO *et al.*, 2005; CASSIOLATO & LASTRES, 2005).

Cassiolato & Lastres (2005), understand innovation as a systemic phenomenon, from the perspective of the National Innovation System - SNI, focusing the discussion about the company in the generation of innovation, shifting to the discussion of the academic context. In the National Innovation System, the generation, assimilation, use and dissemination of knowledge are crucial for the generation of innovation, where the focus on interactions conditions the character systemic and dynamic innovation. In this context, the system depends on structuring aspects shaped by the legal institutional framework. In this approach, learning, generation and cumulation of knowledge contribute to the emergence of innovation, which has a trajectory dependent on previous trajectories. Therefore, the locus of innovation is the company and the university seen as an important support body that generates knowledge and trainer of human resources, which from the Innovation Law can conclude contracts with the productive sector for the transfer of knowledge.[2]

In the scenario of high industrial competitiveness, the repeated search for technological and innovative solutions is visible. According to Araújo *et al* (2022), ICTs, which include universities and federal institutes of education, science and technology-IFs, are no longer only generating knowledge and basic research and start to contribute solutions to society, *through spin-offs*, which can be conceptualized as companies technological-based springs, based on scientific and technological research from ICT, which can be explored in the market, from the intellectual property generated allowing the transfer of technology from the Institution and to society.

The authors point out that in the Amazon they have been the subject of extensive discussions and demands in the face of opportunities to use the extensive potential of biodiversity,

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[2]Thus, macroeconomic and microeconomic, monetary, exchange rate policies, industrial property legislation, innovation law, educational, labor, incentive and tree systems other establish the rules that condition the behavior of different actors who participate in innovation and different *stakeholders.*

under the perception and perspective that, in order to be expanded and used, one must launch in a development project leveraged by Science, Technology, Innovation and Sustainability. Organization for Economic Cooperation and Development, OECD, the Oslo Handbook serves as a reference for government public policies and business policies on innovation, generation, exploitation and dissemination of knowledge, whose themes are fundamental to economic growth, development, and well-being of nations (OECD, 2005).

Thus, it is crucial to have metrics for evaluating the innovative process, because the dynamics of the market and the speed of emergence of new products, processes and services lead to a fierce competition between companies and countries, in the search to develop more and more innovative products and services to meet the needs of customers, differently, in addition to contributing to the growth and economic development of nations. OECD is the world reference in studies on innovation and in the establishment of parameters for its measurement with indicators that allow comparative studies between member and non-member countries, and the Oslo Handbook, among its edited manuals, which addresses the theme more comprehensively incorporating other forms of innovation, in addition to technological innovation, to understand its impact in different countries with different stages of development. Thanks to the standardization of parameters for data collection and for the preparation of national research,[3]these studies can serve as guides for systematization of indicators and standardization of methodologies used internationally for comparative research on the innovative effort of countries (VIOTTI, 2003).

In this context, the objective of this article was to contribute with the Institutions of Science and Technology-ICTs in public policies and in the transfer of technology of products developed by biotechnological spin-offs to the market, successful in the path of innovation of the academic bench until reaching the market.

METHODOLOGY

This is an exploratory, bibliographic, documentary study with a qualitative approach. We consulted the legal instruments that affect the innovation environment considering the adoption of *biotechnology spin-off in* the Amazon, in ICTs, as a way to transfer their knowledge to the market. Among the legal framework researched are: The Federal Constitution, the Legal Framework of Science, Technology and Innovation and its regulatory decree, the Law of Good, *the legal framework of startups* and innovative entrepreneurship, the National Biodiversity Law, Intellectual Property Law and the National Biosafety Policy. The documents analyzed on the

[3] Examples of publications are the Frascati Handbook; the Technological Balance of Payments Manual; the Patent Manual; the Canberra Handbook; and the Oslo Handbook.

theory of innovation, were Schumpeter's postulates to the Oslo Manual and Frascati, his understanding of the innovative environment of Amazonian ICTs.

Scientific articles and public policies aimed at regional bioeconomy were consulted: Guidelines for the Conceptual Construction of Bioeconomy in the Amazon. The analysis followed the comparative methodology; the legislation on the subject was investigated, stopping it with data and projections of specialists in the area, aiming to evaluate the legal effectiveness applicable to the subject.

Institution of Science and Technology (ICT)

At the beginning of the second decade of the 21st century and, through the challenges that arise, the role of science and technology producers reaches a strategic position, the academy has been called to diversify and deepen its forms of relationship with society (CHAVES & ARAÚJO, 2020). Law No. 13,243/16 (BRAZIL, 2016), regulated by Decree No. 9,283/18 (BRASIL, 2018), called the Legal Framework for Science, Technology and Innovation (amends Law No. 10,973/2014), in its Art.1"Establishes measures to encourage innovation and scientific and technological research in the productive environment, with a view to technological training, the achievement of technological autonomy and the development of national and regional productive system of the country", according to the arts. 23, 24, 167, 200, 213, 218, 219 and 219-A of the Federal Constitution.

Law No. 13,243/16 defines the Scientific, Technological and Innovation Institution (ICT) as a direct or indirect public administration body or entity or private entity of non-profit private law legally constituted under Brazilian laws, with its registered office and forum in the country, which includes in its institutional mission or in its social or statutory objective the basic or applied research of a scientific or technological nature or the development of new products, services or processes. The knowledge generated by academic research can provide opportunities for the creation of new companies, especially in high-tech industries. Therefore, the sharing of knowledge by ICT is a crucial factor in promoting innovation and a driving force of the economy (GARCIA ,2020).

A fundamental feature reveals research facilities in Brazil are, with rare exceptions, public. More than that, most of the Brazilian research facilities are within universities Public. Several countries have a much more diversified system, in which public, private institutions and mixed models coexist, based on public-private arrangement. (TURCHI & MORAIS, 2017)

The Brazilian National Innovation System (SNI) presents the innovative effort mostly coming from the academic environment as opposed to other NIs, where this effort is carried out and shared intensely by the private sector. This discrepancy evidences the distance between the academic sector and the Brazilian productive sector and the underutilization of scientific and

technological research parks also due to the low interaction with the productive sector (DE NEGRI and CAVALCANTE, 2013).

In Brazil, ICTs drive the advancement of scientific and technological development. It is notorious the relevance in bringing the market/industries closer to the university to generate innovation. In this process there has been a stun for this alignment of stakeholders. But there is much to be thought of in what efforts will be needed to turn research into technology, and technology into innovation. This involves organizational culture and needs to be seen and felt throughout the institution, from the perspective of university entrepreneurship ecosystems. To in clued technology transfer in the *generation of spin-offs and in* support of *the emergence of startups*, respectively derived from research projects of ICTs and the flow of ideas and knowledge of the academic environment, through the policy of offering business incubators as a way to support the development of these new innovative ventures can contribute to boost the Brazilian SNI and bring the private sector closer together ICTs. As well as technology parks can contribute to the approximation between the public and productive sectors, facilitating their interactions due to the presence of qualified personnel, specialists and the greater fluidity of knowledge and information in this environment (DE NEGRI E CAVALCANTE, 2013).

In this perspective, it elucidates that the university should contribute to society through teaching, research and knowledge transfer activities. The government encourages entrepreneurial activities by universities with investment in innovation and tries to create an environment conducive to the emergence of collaborative projects and promote the creation of *spin-off companies.* (ANDRADE, 2014).

Innovation: related concepts

Innovation is a word derived from the Latin word "*innovātus*", —in, meaning movement inward, plus the adjective —*novus*, meaning new. Thus, innovation is the movement in search of the new (GRIZENDE, 2011).

For Tidd, Bessant and Pavitt (2008, p.27) Joseph Schumpeter is considered the father of studies on innovation. According to the authors, innovation is something new that adds social value or wealth. Much more than a new product, something innovative can be behind modern technologies, new operational processes, innovative marketing practices, small changes, adaptations, in short, novelties that, in one way or another, generate a gain for those who put them into practice. The Organization for Economic Cooperation and Development (OCDE) is an international organization that promotes cooperation between countries for economic growth and contributes to the growth of world trade. The Oslo Handbook, publication of the OECD and EUROSTAT - Statistical Office of the European Communities is the main document on innovation activities. At the beginning of the 1990s, the European Community, in several studies promoted by the OECD (2005), already defined that innovation was a process characterized by

continuous and intense interaction and feedback, both between the various bodies of the same organization and in different organizations (GIUGLIANE, 2012).

However, for the OECD (2005), Joseph Schumpeter's work influenced the theories of innovation. His argument is that economic development is driven by innovation through a dynamic process in which new technologies replace the old ones, a process he calls "creative destruction". Continuing, the OECD states that an innovation is the implementation of a new or significantly improved product (good or service), or a process, or an innovative marketing method, or a new organizational method in business practices, workplace organization or external relations.

However, this organization explains that innovation policies have developed as an amalgam of science and technology policies, with the vision of a linear process. They take as a preponderant factor knowledge in all its forms considering essential investment in research and development for the emergence of technological innovation, however, despite its fundamental role in economic progress, innovation is a complex and systemic phenomenon, according to the perspective of the SNI. Thus, it confirms in the Oslo Manual that the innovation systems approach involves the interaction of institutions in interactive processes in the work of knowledge creation and in its dissemination and application. However, it is important to recognize that an innovation can also consist of a series of small incremental changes and for innovation to be really considered the novelty needs to be implemented in the market.

The Frascati Handbook (2007) consists of a proposed methodology for the definition of experimental research and development, which is also a publication of the Organization for Economic Cooperation and Development - OECD. This manual attaches great importance to the scientific-technological process for the generation of technological innovation and may contribute to the perception of a linearized view of innovation. However, as stated in the Frascati Handbook, R&D is just one step in the innovation process. Innovation involves a number of activities not included in R&D, such as the final stages of development for pre-production, production and distribution, development activities with a lower degree of novelty, support activities such as training and market preparation for product innovations, the development and implementation of activities for new marketing methods or new organizational methods, called innovative activities.

De Negri (2018), clarifies that the dynamics of innovation is much more complex, full of comings and goings and is not always preceded by a scientific discovery. However, it is also certain that no country in the world becomes more innovative and competitive without a strong scientific basis and capable of producing, in addition to "brains", that is, strong scientific community, and qualified human resources, knowledge that can be used in innovation processes.

It is important to remember – innovation is the fundamental element to increase the quality of life of a population and increase the economic productivity of a country – it is an activity, eminently, private. For this reason, the decrease in business participation in the total R&D effort,

as well as the stagnation of an industry's capacity, are extremely negative data from both the productive and technological perspective, which reinforces the gap between the public and private sectors. In any case, even if innovation occurs in companies, it is also necessary to highlight that government efforts are fundamental to create conditions and environments conducive and safer to innovative processes (MONTEIRO *et al*, 2022).

Science and Technology Institutions (ICTs) can help minimize this scenario, with skilled professionals and laboratories for Research, Development, and Innovation (PD&I). In the conjuncture of Brazilian society, particularly in the Amazon region, among the main current challenges stand out: implementing entrepreneurship actions directed to meet the needs of socioeconomic development; the effort to expand the implementation of innovation practices, in its different modalities and the imperative to create innovative forms partnerships between institutions producing scientific technical knowledge to unite efforts to expand and disseminate knowledge and technologies (CHAVES & ARAÚJO, 2020).

The Ministry of Science Technology and Innovation-MCTI (2013), through the Planalto Palace, instituted Law No. 11,196 of November 21, 2005, known as the Law of Good, in its Chapter III, Articles 17 to 26, and regulated by Decree No. 5,798 of June 7, 2006, consolidated the tax incentives that legal persons can automatically enjoy, provided that they carry out technological research and development of technological innovation, with the objective of supporting Research, Development and Innovation - PD&I.

By determining Law No. 10,973/2004 – Innovation Law, a law 13, 243/2016 was analyzed by Decree 9,283/2018 (Innovation Legal Framework) and reinforced support for technological development and innovation in Science and Technology-ICT institutions and Brazilian companies, as well as was designed to provide incentives for research and innovation, such as: technical cooperation between ICT and private institutions, sharing of laboratories, incubation *of startups*, provision of R&I services, as well as allowing the researcher to work in the company *and the creation of spin-offs*, as well as interaction and technology transfer.

From this understanding, it is important to approach innovation in a systemic view, since it is the result of the interaction of the different agents that make up this system.

Amazonbiodiversity

Biodiversity is responsible for the maintenance of life and the balance of ecosystems Society is growing more and more and with this growth man has developed many technological advances, where in this process biodiversity ends up being threatened, because the human being has not developed the responsibility of caring for the environment (BENSUSAN, 2008; NASCIMENTO *et al*., 2021).

Research on biodiversity in the Amazon is still incipient, with large gaps in relation to the lack of information, the organization of available information, the lack of adequate infrastructure

for the collection and storage of biological material and, mainly, the almost total lack of qualified human resources to perform these actions (INPA, 2012). What is known is that the Amazon comprises one of the largest and most diverse biomes on the planet containing a rich biodiversity of fauna and flora with a high degree of endemism. In an area of almost four thousand km² it integrates eight Brazilian states and 125 federal conservation units (ICMBIO, 2021).

One point to be highlighted is that, when manipulating Amazonian biodiversity to develop genetically modified organisms (GMOs) it is up to ICTs to pay to the biosafety requirements established by the National Technical Commission on Biosafety (CTNBio), according to art. 14, VI da (BRASIL, 2005), and must seek the Certificate of Quality in Biosafety (CQB) (art. 14, XI), and penalty is imposed if there is non-compliance with such precepts (art. 22 § 3).

The National Biodiversity Law (BRASIL, 2015), which regulates some articles of the Federal Constitution and the Convention on Biological Diversity, does not exclude itself from the issue of innovation tied to biodiversity – even when it comes to innovation based on traditional knowledge (Art. 2, IV). It also provides for the distribution of benefits for projects for conservation or sustainable use of biodiversity or for the protection and maintenance of knowledge, innovations or practices of indigenous populations, traditional communities or traditional farmers, preferably at the place of occurrence of the *species in situ condition or obtaining* the sample when it is not possible to specify the original location (art. 19, II, a). Such legal institutions especially affect Amazonian biodiversity, which permeates the largest concentration area of traditional communities in Brazil (ISPN, 2020).

Brazil, (2021) Evaluates biodiversity from the perspective of the legal framework *of startups* and innovative entrepreneurship that instituted its principles and guidelines the recognition of innovative entrepreneurship as a vector of economic, social and environmental development (Art. 3°, I). Specifically regarding Amazonian biodiversity, it should be noted that none ICT can consider invention all or part of natural living beings and biological materials found in nature, or even isolated from it, including the genome or germplasm of any natural living being and natural biological processes (art. 10, IX), according to the Industrial Property Law (BRASIL, 1996).

JOURNEY OF A "*SPIN-OFF*" AND BIOTECHNOLOGY

Bioeconomy refers to the set of economic activities of production, promotion of the production, distribution and consumption of goods and services from resources of sociobiodiversity (SECTI-SEDECTI, 2022).

Spin-offs are companies generated from a research project developed within universities or Federal Institutes. They are mechanisms for transferring knowledge from higher education institutions - HEIs to the market. *Spin-offs* have been widely used to boost innovation and regional development, undertake the outsourcing of economically relevant knowledge, created in ICT.

This knowledge is outsourced by the creators and exploited economically in the form of a *startup.* (GARCIA, 2020; KARNANI, 2012)

The Legal Framework of Innovation aims to expand the partnerships between universities and companies to contribute to the technological development of the country. It aims to establish better relationships between research institutes and the productive sector. The idea is that the results of research can generate *spin-offs* and patents, however, resistance is still observed on the part of researchers. Often, the preference is for the publication of a scientific article, making the public knowledge, and without the protection of the patent, any company can appropriate the idea and, if it does, Brazil is forced to *pay royalties* to reproduce it.

S*pin-off* is defined by Scott Shane, American professor and researcher, as a company created to exploit an intellectual property generated from a research work developed in an academic institution. A company created by a person without any link with a university, if knowledge originates from an academic institution, is also considered a *spin-off*. However, when knowledge or intellectual property does not come from a university, even though companies are created by employees or former employees of academic institutions, they are not considered a *spin-off*. (PEDROSI FILHO, 2020).

The successful *spin-off* company is the one that has property, makes the transfer of technology from the university to society, generates innovation, generates value and fulfills its mission. The "university" actor considers the successful *spin-off* company as the one that "carries out the transfer of knowledge to society". However, the authors mention, for *the entrepreneurs of spin-offs the definition* found is awfully close to that contained in the literature: The *successful spin-off* is one that has significant revenues, is recognized by the market, has stability and financial security, and realizes its vision (OLIVEIRA *et al* 2017),

The *spin-offs* present information difficulties around business management, since the development of marketing plans, strategic partnerships, sales and financial management, since most managers, of this type of company, originate from the academy and do not have training or experience in business management (AMARAL, 2021).

This fact is observed mainly in biotechnology companies, because it can be highlighted that biotechnology is a relatively new area and the entrepreneur is generally a researcher who concentrates the main source of information within the institution as a university project and the information it has is located strongly in knowledge and technology involved for product development, results of scientific research. The biggest challenge for biotech companies is to transform their business into a business model that is efficient and is an interface between developed technology and economic value creation. Taking this statement into account, one observes the difficulty of a *spin-off* in transferring its technology to society. According to the author, published studies on the commercialization of knowledge, through the creation of *spin-offs*, are still scarce. However, the extent with which this mechanism can be used depends on how

the different factors can influence the creation, development and performance *of spin-offs*, such as support in the management and conduct of the product to the market. This can be solved with the support of incubators and/or business accelerators (AMARAL, 2021)

Goulart (2022), in a recent lecture at INPA, clarifies that the Brazilian Legal Framework allows a series of flexible measures for innovation and *spin-off development*, but the internalization of these measures in the university is complex, given the autonomy they have and do not use the solutions pointed out. It mentions that in other countries universities are *members of spin-offs, receiving royalties*, but these opportunities, allowed by the Legal Framework, are not yet absorbed by Brazilian universities. The 2020 World Economic Forum (WEF) has been going on every year since 1971 and brings together the world's leading economic leaders to discuss emergency issues on a global stage. At the 2020 hollow event between 21 and 24 January in Davos, Switzerland, a report on the professions of the future was released.

Where he points out that, with the technological advances that are giving rise to the so-called fourth industrial revolution, there will be a significant change in the profile of professionals in the coming years. The development of artificial intelligence, machine learning, robotics, nanotechnology, 3D printing, genetics and biotechnology will generate a transformation in business models and lab our markets. Through this report, it is observed that it will not only be technology (Information, Data and Engineering) as one of the trends of the global economy, but also a great rise in careers focused on marketing and content.

Another highlight is the Green Economy, which has been growing with more sustainable alternatives for various sectors of industry and products. It is note point that Biotechnology is part of Green Technology, abundant in the Amazon, which can be an excellent opportunity for ICTs *to generate spin-off* in this area for the transfer of knowledge to the market, with sustainability and encouraging the development of the regional economy. Green technology is part of a concept that seeks to determine a sustainable production process, applying good techniques to cause fewer possible impacts to the environment. (ARAÚJO *et al*, 2022)

A *spin-off* is structured from the use of intellectual property (IP), and IP is a mechanism of formal appropriation of knowledge, which allows the commercialization of the intangible asset and the recovery of investment. In knowledge-intensive areas with a high degree of uncertainty and high risks and investments, IP inhibits copying and imitation, allowing the appropriation of the value generated to the innovative agent. In addition, technological mapping is essential for the detection of the state of the *art and freedom-to-operate* for non-infringement of the right of third parties.

Knowledge-intensive technology-based nascent companies, subject to risks and uncertainties, *especially spin-offs* should use the patent system both for the appropriation of technology, as well as for monitoring competitors and conducting prospecting and prospective studies to monitor trends in technological trajectories under different scenarios. The *spin-offs*

should use this technological mapping to avoid failure, and it is extremely important that these nascent ventures deepen in this theme (GOULART,2022).

The program "Green Patents", promoted in Brazil by the National Institute of Industrial Property (INPI-BR), has as main objective to gather and accelerate the examination of patent applications that include innovations related to the environment new technologies and sustainable development (RICHTER, 2014)

These indicators enable Spin-*Offs* to obtain the charter with a reduction of up to 90% of the normal examination period. This reducing bureaucracy reaffirm that patents constitute the oldest forms of protection of intellectual property, whose objective is to encourage economic and technological development rewarded by creativity (TEIXEIRA, 2017).

A sociedade vivencia a tecnologia em todos os momentos, e a sala de aula, assumi a função de desenvolver potencialidades, firmada como um espaço-fim para experimentar esse processo de transformação e estímulo a criatividade e inovação (ALMEIDA & OLIVEIRA,2021).

Brazil has relevant academic skills in several areas, but excessive bureaucracy and a poorly dynamic business environment make it difficult for new knowledge in universities to produce new TRL products. The beginning of the *journey of a spin-off*, has a high degree of risk, high investment can hinder the capture of new investors, being fundamental the role of public investment (DE NEGRI, 2018; GOULART, 2022).

The trend is that the risk *of spin-off* decreases, as the technology is developed and value to the product will be incorporated, the results obtained are being observed with the generation of knowledge provided by the implementation of innovation as intrinsic elements of the stage of value capture, const ruining indicators that are monitored by the market. (LOURENÇÃO, MAGELLAN, ROLAND, 2021)

For a research to have market results the researcher must start with prospecting and know the difference of the technology he is developing; should evaluate the degree of maturity of the technique (TRL); model the business in CANVAS to understand its Business Model and structure its Business Plan (PN), which should contain the planning of management, marketing, technological, financial and laboratory infrastructure (multi-user or not) , that is, plan the entire operational, budgetary and financial management of the future company.

It becomes important to map multidisciplinary people for the entrepreneurial journey, with a scientist and business profile, as well as other ingredients needed to maintain the project (skills assessment, definition of advisors, verification of professional framework, definition of clear attributions, governance structure and always check what is being practiced in the market (GOULART, 2022).

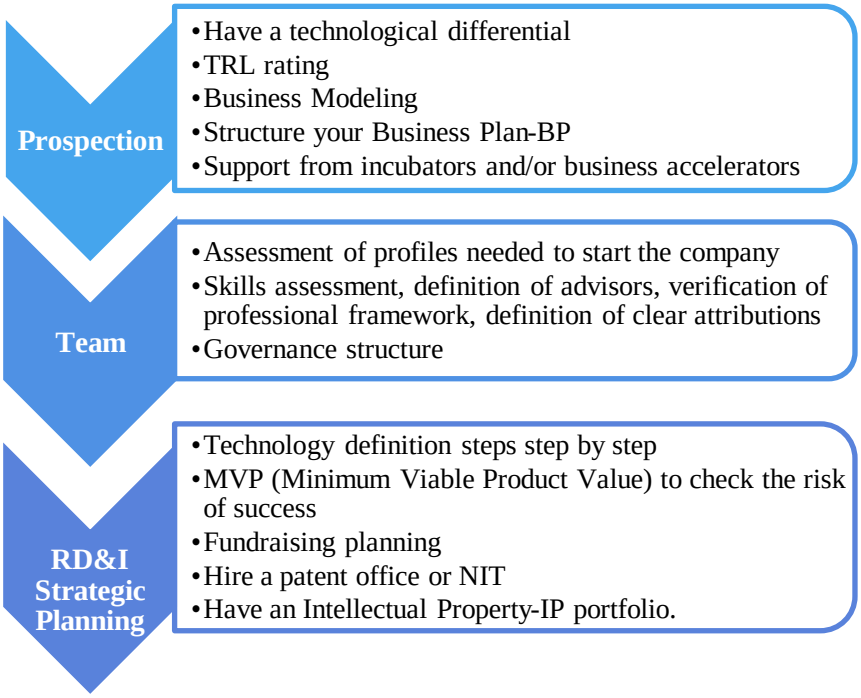
To achieve success in its journey to the *market, the spin-off must* develop its strategic research and development (R&D) planning with the steps of defining technology step by step, from the first test and then, when the technology is defined, elaborate an MVP (minimum viable

product value) to verify the risk of success. Explains *that the spin-off* should have fundraising planning (economic grant, private investment, or own *resources), make benchmarks, hire patent office* or Technological Innovation Center - NIT, being important to be international patent and have industrial property-PI portfolio. From this planning the *spin-off* and future *startup* must understand what its competitive advantage, entrepreneurial capacity and business environment will participate.

SEBRAE (2022), the mechanisms for generating innovative enterprises (business incubators, accelerators, among others) have as objective to stimulate the emergence of innovative companies, as well as prepare the nascent companies for their consolidation and growth in the market. The support of one of these mechanisms can be fundamental to the development and maturity of the company and generate better results.

Figure 1 highlights the journey that a *spin-off should* follow to obtain expressive results in the insertion of the product/service in the market.

FIGURA 1- jornada de um *spin-off*[4]-



Fonte: ARAUJO, MUNHOZ. CABRAL. SILVA, LASMAR (2022)

At the University, particularly in the Amazon region, among the main current challenges stand out: implementing entrepreneurship actions directed to meet the needs of sustainable socioeconomic development. Biotechnology is a means to develop biodiversity

[4] based on Goulart's talk in /2022

products with preservation of ecosystems. Finally, there is a need for a greater effort to expand the implementation of innovation practices, derived from technological research in biotechnology to technology transfer, through spin-off and encourage their journey of market access.

FINAL CONSIDERATIONS

The work dealt with the issue of technological innovation through "Spin-off" of biotechnology in the Amazon in science and technology institutions-ICT and its journey to the market. There are many expectations about the future of this area in the Amazon region, given its recognized biotechnological vocation.

It was concluded that for the best result in biotechnological innovation in the Amazon, it is necessary to join efforts of the private sector, government, and spin-offs of ICTs. The latter can contribute to skilled professionals and laboratories for Research, Development, and Innovation (R&D), to respond to the needs of sustainable socioeconomic development, through market access.

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