

**DEVELOPMENT OF ALTERNATIVE BUSINESS MODELS FOR THE  
AERONAUTICAL AND AEROSPACE INSTITUTE OF MULTIDISCIPLINARY  
TECHNOLOGIES IN PUERTO RICO**

by

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## ABSTRACT

This project aims to develop alternative business models for the Aeronautical and Aerospace Institute of Multidisciplinary Technologies, projected Division of the Aeronautical and Aerospace Institute of Puerto Rico, Inc., corporate subsidiary ascribed to the *University of Puerto Rico* (UPR) in Aguadilla. Alexander Osterwalder's and Yves Pigneur's, Business Model Canvas methodology was used to develop theoretically informed conceptual alternative business models for the Divisions' aim of financial sustainability, as well as to contribute to the growth of the aeronautical and aerospace industry in Puerto Rico. It includes a Canvas for each of the three-primary target segments identified by management, which are the following: A) An entity, agency, or company local or international interested in *research and development* (R&D) projects; B) UPR researchers with federal, UPR, and/or public funding support for R&D projects; and C) UPR researchers with any type of funding support for R&D projects. The evaluated areas were: 1) a description of the commercialization process in the University of Puerto Rico; 2) a description of the aeronautical industry and the Divisions; and 3) the exploration of means to apply the Canvas in the university context and the aerospace industry. Interviews were conducted with expert key-informants to ensure the reliability and validity of the Canvases. The last step was the development and comparison of the three Canvases for the Division. Suggestions and recommendations on such are also presented.

## RESUMEN

Este proyecto se enfoca en desarrollar modelos de negocios alternativos para la División de Tecnologías Multidisciplinarias del Instituto de Aeronáutica y Aeroespacial de Puerto Rico, Corporación Subsidiaria de la Universidad de Puerto Rico (UPR) en Aguadilla. La metodología del *Business Model Canvas* de Alexander Osterwalder e Yves Pigneur fue utilizada para formular modelos de negocios alternativos conceptuales para la División, enfocándose en sostenibilidad financiera y el crecimiento de la industria de aeronáutica y aeroespacial en Puerto Rico. Se incluye un *Canvas* para cada uno de los tres segmentos objetivos identificados por la gerencia, siendo estos los siguientes: A) entidades, agencias, o compañías locales e internacionales interesadas en proyectos de investigación y desarrollo; B) Investigadores de la UPR con financiamiento de fondos federales, públicos o de la UPR para proyectos de investigación y desarrollo; C) y investigadores de la UPR con cualquier fuente de fondos para proyectos de investigación y desarrollo. Las áreas evaluadas para cumplir con el objetivo del proyecto incluyeron: 1) una descripción del proceso de comercialización en la Universidad de Puerto Rico; 2) una descripción de la industria aeroespacial; 3) y explorar maneras para aplicar el *Business Model Canvas* al contexto universitario y a la industria aeroespacial. También se ejecutaron entrevistas a personal experto en áreas claves para lograr validez y precisión en los *Canvases*. El último paso fue desarrollar y comparar los *Canvases* para la División. Sugerencias y recomendaciones sobre estos a su vez fue brindada.

## **DEDICATION**

To my parents, Edmée Valle Ruiz and Sem Cortés Rosario for giving me life, always being there for advice, and providing me with unconditional love.

To my two mother-cousins, Ibis Menéndez Valle, for considering me as your own daughter, and being the first person to inspire me to apply at the UPRM and Minerva Salcedo Valle, for raising me and always being there taking care of me.

To my aunt, Ibis Valle Ruiz, for becoming my grandmother when I had none.

To all of my family, for always being so close to each other even when thousands of miles away.

To Eragon, for always soothing me when needed and for being my companion for the past ten years.

Thanks.

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## **LIST OF ABBREVIATIONS**

AACST	Aeronautical and Aerospace Center for Services and Training
AAIC	Aeronautical and/or Aerospace Industry/Industrial Cluster
AAIMT	Aeronautical and Aerospace Institute of Multidisciplinary Technologies
AAIPR	Aeronautical and Aerospace Institute of Puerto Rico
BMC	Business Model Canvas
BQN	Borinquen/Rafael Hernández Airport
CAUSE	Center for Aerospace and Unmanned Systems Engineering
EASA	European Aviation Safety Agency

EDA	Economic Development Administration
FAA	Federal Aviation Administration
GSFC	Goddard Space Flight Center
IP&TTO	Intellectual Property and Technology Transfer Office, from UPRM
IP	Intellectual Property
MRO	Maintenance Repair and Overhaul
NASA	National Aeronautics and Space Administration
TT	Technology Transfer
PRATC	Puerto Rico Aerospace Technology Consortium
PRIDCO	Puerto Rico Industrial Development Company
PROMESA	Puerto Rico Oversight, Management, and Economic Stability Act
PRST-TTO	Puerto Rico Science, Technology and Research Trust Technology Transfer Office
PRTEC	Puerto Rico Techno-Economic Corridor
R&D	Research and Development
SBIR	Small Business Innovation Research
STEM	Science, Technology, Engineering, and Math
SWOT	Strengths, Weaknesses, Opportunities, and Threats
UPR	University of Puerto Rico or University
UPR-Ag	University of Puerto Rico, Aguadilla Campus
UPRM	University of Puerto Rico, Mayagüez Campus
U.S.	United States of America
USPTO	United States Patent and Trademark Office

## **FONTS THROUGH WRITTEN BODY**

*Italics* – Used for terms that are going to be abbreviated

**Bold** – Used for glossary words in text and for chapter or section identifier.

## **GLOSSARY**

1. **Applied Research** – The consideration of available knowledge to solve actual problems with the creation and application of products, operations, methods or systems (Organization for Economic Co-operation and Development, 2015, p. 50). “Systemic, intensive study directed toward the practical application of knowledge” (University of Puerto Rico, 2012, p. 117).
2. **Business Model** – “Process of creating, delivering and capturing value”, which translates to converting a new technology to economic value and delivering it to a customer (Allen, 2010, p. 175).
3. **Business Model Canvas (BMC)** – Method for strategically analyze and plan the management of a business in an organized visual way (Hanshaw & Osterwalder, 2015).



4. **Cluster** - The National Bureau of Economic Research defines clusters as geographical concentrations of industries related by knowledge, skills, inputs, demand, and/or other linkages (Delgado, Porter, & Stern, 2014).
5. **Codes** – “Codes are labels that the research team applies to data” (Choo, et al., 2015, p. 8). It groups data so it can be further analyzed (Choo, et al., 2015). Every code coincides to a concept, idea, or theme (Choo, et al., 2015).
6. **Commercialization** – “Process of turning a concept into a product, process, or service which is sold in the marketplace” (Servo, 2005, p. 15). “Identification of companies or users that might be interested in using the invention or patent or technology or related processes in exchange for an exclusive or non-exclusive license, equity, or any type of agreement” (University of Puerto Rico, 2017, p. 2).
7. **Copyright** – The holder has the “right to exclude others from reproducing the work, preparing derivative works, distributing copies, and displaying the work in public” (Allen, 2010, p. 69). “Intangible, incorporeal right granted by statute to an author or originator of certain literary or artistic productions, where he/she is invested, for a limited period, with the sole and exclusive privilege of multiplying copies of the same and publishing and selling them.” (University of Puerto Rico, 2012, p. 119).
8. **Inductive Approach** – “allows for codes, themes, and ideas to arise from the narrative – but nevertheless starts with some priori hypotheses and perspectives” (Choo, et al., 2015, p. 1106).
9. **Invention** – “any discovery, invention, process, manufactured article, design, model, technical development, biological material, varieties, cultures of any organism, or a portion, modification, transference or extension of the previously mentioned and other related processes” (University of Puerto Rico, 2017, p. 3).
10. **Inventor or Researcher** – “member of university community who have done research or made the discovery” (University of Puerto Rico, 2017, p. 3).
11. **License/Licensing** – “permission of the owner of the patent or invention to use the same” (University of Puerto Rico, 2017, p. 3). Allows the technology to be disseminated in exchange for royalties (Servo, 2005).
12. **Patent** – “Property granted by the *United States Patent and Trademark Office* (USPTO), or similar international offices, that permits the owner to exclude others from making, using, selling, or offering a patented invention for sale during the effective term of the patent” (University of Puerto Rico, 2017, p. 3).

13. **Qualitative Research** – “Strives to collect, integrate, and present data from a variety of sources of evidence as part of any given study” (Yin, 2011, p. 9). Means to explore, explain, and describe one or several topics utilizing primary and secondary data (Marshall & Rossman, 2006, p. 33).
14. **Research and Development (R&D)** – “Includes all research activities, both basic and applied, and all development activities that are supported at universities and colleges. Demonstration projects conducted to discover whether a technology or method is workable are considered to be within the scope of R&D if their objectives is to produce new information within a specific time period” (University of Puerto Rico, 2012, p. 130).
15. **Spinoff** – Entity created but part of an established firm with the purpose of commercialize an invention (Chukumba & Jensen, 2005). Intellectual property generated typically in the university by the scientist or a graduate student working in the industry used to create a commercializable product or service. Usually owned or co-owned by the university (Wennberg, Wiklund, & Wright, 2011).
16. **Startup** – New entity, usually a small business formed separately. Sometimes also created as a separate entity but with support of universities for the commercialization of inventions from university inventors (Chukumba & Jensen, 2005).
17. **Strength Weaknesses Opportunities and Threats (SWOT) Matrix** – External (Opportunities and Threats) and internal (Strength and Weaknesses) variables among the organization used to find a fit among the entity mission, objective, strategy, and policies for optimal strategic management planning (Wheelen, Hunger, Hoffman, & Bamford, 2015).
18. **Trademark** – According to Allen (2010), under the Lanham Act of 1946, a trademark “must consist of a device, symbol, name, work, or combination that the USPTO has defined valid”, and it also should be a distinguishable mark (p. 71).
19. **Technology Transfer** – “Occurs when a technology developed or used in one unit of an organization is adopted by another unit of that organization or another organization” (Speser, 2008).
20. **University of Puerto Rico (UPR) Corporate Subsidiary** – Entity created by the University, registered under the Commonwealth of Puerto Rico as a non-profit, usually ascribed to a UPR Campus.

# 1. INTRODUCTION

## 1.1 Project Overview

The *Aeronautical and Aerospace Institute of Puerto Rico* (AAIPR or Institute) was created to fulfill the needs and propitiate the development of the *aeronautical & aerospace industry cluster* (AAIC) in Puerto Rico (Arroyo, 2015b). The Institute concept originated with a partnership between the corporation Lufthansa Technik and the Commonwealth of Puerto Rico to provide an educational option for aviation mechanics and engineers. It is a non-profit corporate subsidiary ascribed to the *University of Puerto Rico in Aguadilla* (UPR-Ag) located in the *Rafael Hernandez Airport* (BQN). See Appendix A for other ***University of Puerto Rico (UPR) corporate subsidiaries***.

As stated by Arroyo (2015a), the AAIPRs “vision is to become the main driver of the growth and expansion of the AAIC in Puerto Rico. Its mission is to position the UPR as an international leader in aerospace and aeronautical programs, as well as services and operations of *maintenance, repair and, overhaul* (MRO) of aircrafts and related disciplines” (p. 1). Figure 1 shows the outside premises of the AAIPR main building.



**Figure 1:** Outside premises of the Institute. Image obtained from (Quevedo, 2015).

The Institute is currently composed of service areas such as academic offerings, facility rent for industry companies, and a training center for industry related companies. To further develop the ecosystem of the AAIC in Puerto Rico, “the AAIPR is focused in developing the

three components: 1) innovation by supporting research, development and commercialization of products and *intellectual property* (IP); 2) infrastructure development; 3) and diversity of academic degrees, alternatives and certification programs in aerospace and related industries” (Arroyo, 2016a). The component or division already in operation is the *Aeronautical and Aerospace Center for Service Training* (AACST) which is the area in charge of offering the current MRO programs (Arroyo, 2016a). Their next service initiative will be the *Aeronautical and Aerospace Institute of Multidisciplinary Technologies* (AAIMT or Division) *research and development* (R&D) facility (Arroyo, 2016b). The AAIMT “will focus in providing R&D services, IP development, and a *technology transfer and commercialization* (TT&C) platform” for the generation of new innovative, driven enterprises (Arroyo, 2015a, p. 1) Appendix B provides a more detailed description of the AAIPR projected divisions initiatives, current offerings, administrative composition, and operational structure.

This project focuses on developing alternative business models for the AAIMT, next projected division of the AAIPR; it is necessary for the Institute to have options to assess the potential sustainability and growth for the AAIMT. A **business model** is “how an organization creates, delivers, and captures value” (Osterwalder & Pigneur, Business Model Generation, 2010, p. 14). The ***Business Model Canvas (BMC)*** methodology, developed by authors Alex Osterwalder and Ives Pineaur (2010), enables the conceptualization of simple alternative business models for new ventures, which could be considered, discussed, and subsequently validated by founding teams during implementation.

The BMC tool excels for developing business models in different ecosystems achieving the mentioned purposes, so it is reasonable to determine it can be applied to develop several alternative conceptual business models to promote the sustainable delivery of services to the various market segments targeted by the AAIMT. The tool provides a simple method to visualize, describe, and evaluate alternative business models. Through its application, this project aims to identify the options available to management for the deployment of services the AAIMT will provide, and the potential approaches for the UPR *technology transfer* (TT) programs and facilities.

## 1.2 Justification

According to Arroyo (2016a), the AAIPR “creates a knowledge ecosystem that supports and helps to grow the AAIC of the Island in alliance with public policy and socioeconomic development strategies” (p. 5). To maintain this role and proceed with their Socio-Economic Development Strategic Project, the Institute must continue with the development of the projected initiatives. The Commonwealth of Puerto Rico provided the AAIPR a financial jumpstart, but it is expected to become financially self-sustainable in the medium term. The academic offerings and training center components are being self-sufficient to operate but not with enough capital surplus to further develop the AAIPR and meet the expected goals (Arroyo, 2017).

Given the importance that the AAIMT component of the Institute will bring to the overall Island economy, strengthening it towards becoming the primary driver of growth and expansion of the AIC in Puerto Rico, a proposal was submitted to the U.S. *Economic Development Administration* (EDA) for partial funding (Vega & Santiago, 2016). There were \$4.57 million granted by the U.S. Department of Commerce through the EDA in October 2017 for partial funding recognizing that its establishment has the potential to generate 542 jobs and \$5 million in private investments (U.S. Economic Development Administration, 2017). The overall projected investment is expected to have an economic impact of \$3.5 billion in 5 to 15 years, generating 96,000 direct jobs (Arroyo, 2016a). Once the initial investment is made, the management of the Division expects that within three to five years of operating; the AAIMT should become self-sustainable through its own revenue streams and synergies with the consideration of the existing operational structure of the AAIPR (Arroyo, 2016b). The Institute administration is aware that the current fiscal crisis of the country will not allow the AAIPR to be dependent on financial subsidies or funds from the Government nor the UPR-Ag on a longer term.

The BMC is a methodology used to develop alternative business models adaptable to many kinds of businesses, adopted by universities (Hanshaw & Osterwalder, 2015). This tool delivers a simple method to visualize, describe, and evaluate alternative business models (Osterwalder & Pigneur, 2010). The tool was chosen due to its adaptability, prior AAIMT management familiarity with it, and validation from external expert users. It will provide

management the ability to explore possible scenarios to assess the best outcomes to be executed. Through its application, this project aims to identify for management the options available for the deployment of services the AAIMT will provide, and the potential approaches for the UPR TT programs and facilities. By using the BMC, it is intended the AAIPR will have alternative business models that could be easily adapted to their changing needs, therefore, evaluate viable alternatives the AAIMT could offer before getting involved in a lengthy or capital consuming process.

### 1.3 Objective

The objective of this project is to generate a set of business models for the AAIMT Division of the AAIPR using the BMC method developed by Alexander Osterwalder and Yves Pigneur. These will include a BMC for each primary segment identified by the management of the AAIMT. The AAIPR Director identified three main target segments for their proposed AAIMT division. The three target segments with commercialization goals identified by management were the following: 1) Entity, agency, or company local or international interested in R&D projects; 2) UPR **researchers or inventors** with federal, UPR, and/or public funding support for R&D project; and 3) UPR researchers with any type of funding for R&D project. (Arroyo, 2017).

The scope of the project includes the areas to be evaluated to achieve the project objective of generating business models for the identified segments using the BMC. The evaluation areas to are to explore the benefits and limitations of the Division goals set by the management, this is the AAIMT goals of providing R&D services, IP development, and TT&C platform, considering being part of the UPR. The second area is to assess the AAIC considering the AAIMT goals. The last area is to explore the BMC's utility, so it can be used to develop business models for the Division. These areas can be summarized as; 1) a description of the commercialization process for the technologies created within the context of the UPR; 2) a description of the AAIC ecosystem applicable for the AAIMT, and 3) manners in which the BMC tool can be applied to university context and the aerospace cluster.

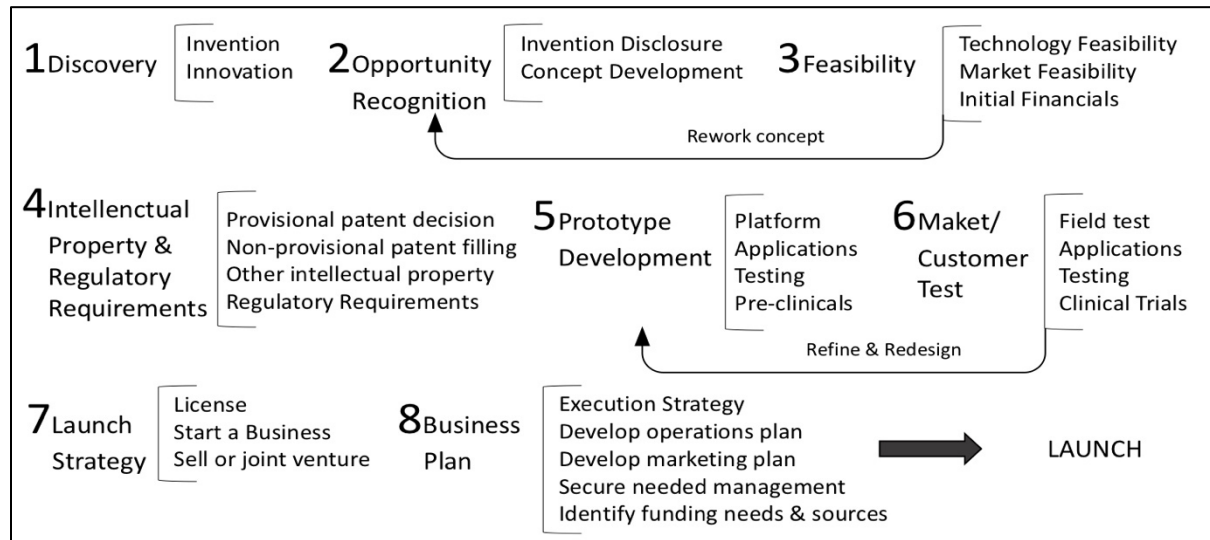
#### **1.4 Importance of the Project**

This is an **applied research** project which offers a compilation of the current state of the aeronautical and aerospace industry. Aiming to generate more in-depth options towards the AAIMT sustainability within the context of its mission to serve as commercialization platform. It can be used as an instrument to determine current and future goals for the AAIMT. It may also contribute to the knowledge of the AAIC and to the application of the BMC in similar corporate subsidiaries at UPR in the Island.

## 2. LITERATURE REVIEW

### 2.1 Commercialization Process at the UPR

A commercialization process begins with an invention or technology transferable to an interested party with an exchanging agreement (Speser, 2008). These inventions are a result of *research and development* (R&D) projects led by researchers (Speser, 2008). Figure 2, shown below, depicts the commercialization process from author Allen which follows a general scheme for science and engineering discoveries in eight steps with further subdivisions (2010). These steps are discovery, opportunity recognition, feasibility, *intellectual property* (IP) & regulatory requirements, prototype development, market/customer test, launch strategy, and business plan (Allen, 2010).

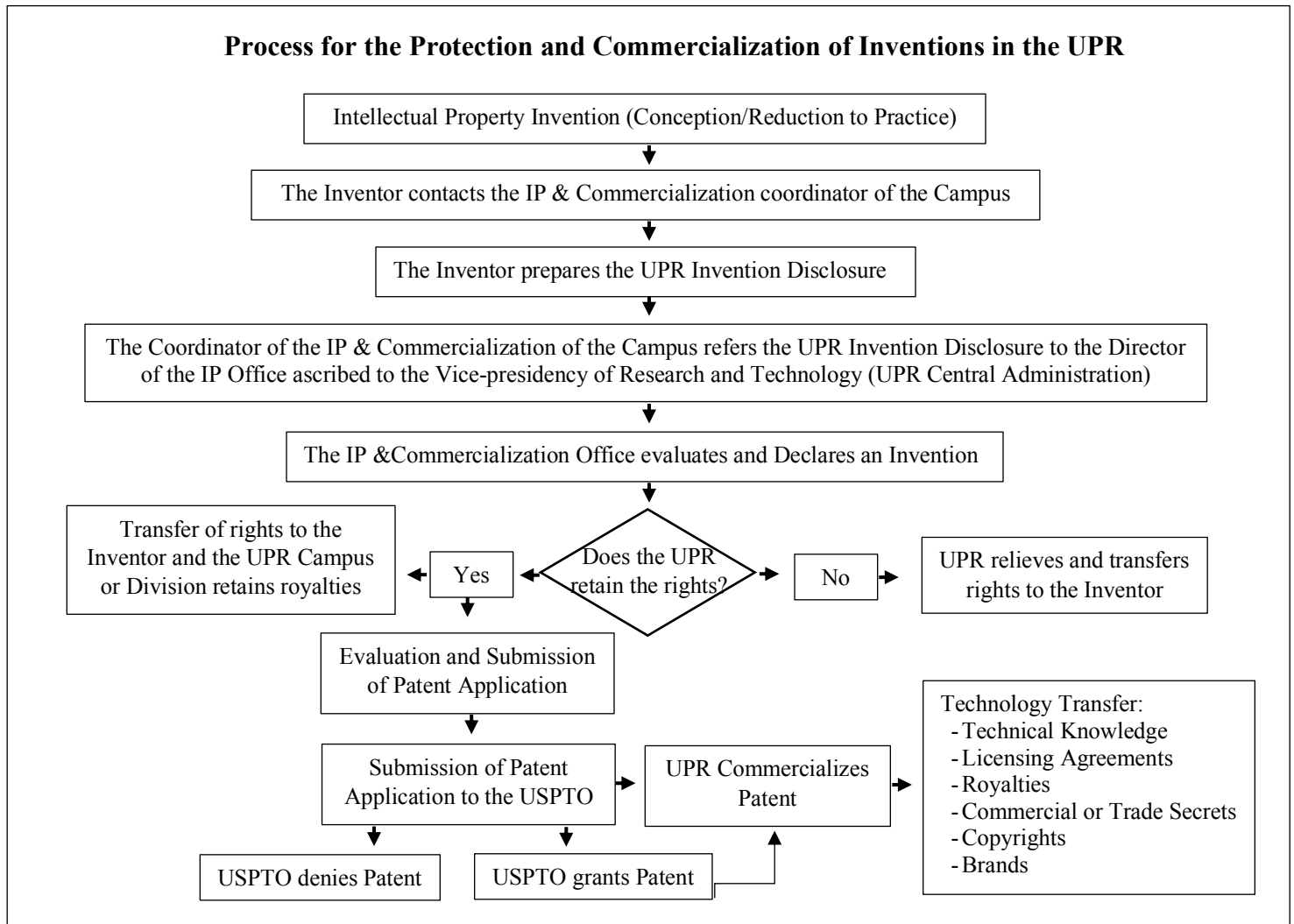


**Figure 2:** The Commercialization Process (Allen, 2010, p. 10).

Having a similar process as Allen's, the *University of Puerto Rico* (UPR) established a patenting and commercialization process for their innovations displayed in Figure 3 on page 6. This figure depicts the Process for the Protection and Commercialization of Inventions in the UPR; it illustrates the various steps an invention in the UPR has to go through before it can be commercialized. For the innovation process to take place, there should be a research project leading to the invention (Speser, 2008). The UPR is well-known for R&D of new technology or products within *Science, Technology, Engineering, and Math* (STEM) disciplines and, according to the Statistics Institute of Puerto Rico, it is responsible for 83% of the capital invested in R&D from universities in the Island in 2011 (as cited in Escalona, 2015).



Encouraging inventions, there was an increase of 51.22% in R&D investments for UPR principal campuses, from 2007 through 2011 (Escalona, 2015). As a result, there were 124 invention disclosures and 108 patent applications submitted to the *United States Patent and Trademark Office* (USPTO) from 2008 through 2013 (Escalona, 2015). In that period, only 19 patents were obtained from which 11 of them were from agreements and collaborations with other universities or private entities, and other seven were obtained by licensing agreements (Escalona, 2015). Figure 3 illustrates that the UPR holds the rights of the inventions created by the researchers/inventors (University of Puerto Rico, 2002). Table 1 shows the percentage of royalties or net income distribution if an invention were to be licensed (University of Puerto Rico, 2017).



**Figure 3:** Process for the Protection and Commercialization of Inventions in the UPR – Translated from Spanish by the author (*University of Puerto Rico, 2011*).

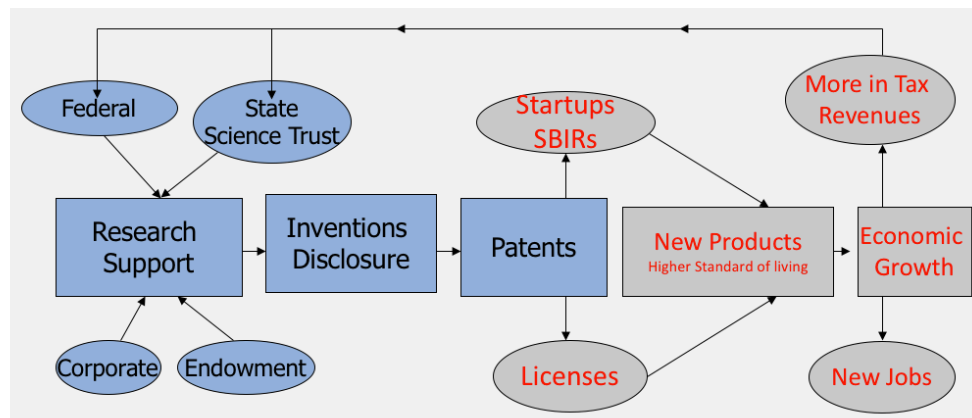
UPR Patent Net Income Distribution UPR Ownership is 100% of the Intellectual Property	
	Current
<b>Inventors</b>	33.33%
<b>UPR Central Administration</b>	10.00%
<b>UPR Campus (of Invention)</b>	10.00%
<b>Department (of Invention)</b>	46.67%
<b>Laboratory (of Invention)</b>	-

**Table 1:** UPR Patent Net Income Distribution. Table created from information provided in (University of Puerto Rico, 2017).

According to Lobato's and Vega's study, "researchers are more inclined to journal publications than creation, this, according to their perception of successful research" (2014, p. 5). Recent R&D and innovation in the UPR has increased the quantity of IP [not necessarily protected] but not the commercialization of such. Lobato & Vega also found that researchers feel there is lack of time and support from the University to undertake the research leading to commercialization (2014). Their study highlighted the significantly slow patent process in the UPR and the low or inexistent level of commercialization available when compared with universities in the U.S. (Lobato & Vega, 2014).

The UPR Office of the Vice President for Research and Technology shows, in Figure 4, a complementary flowchart to Figure 3. The UPR has been able to successfully achieve up to the patent step of Figure 4 (Escalona, 2015). The Figure depicts from when federal funding is received up to patent mark in blue showing adequacy. Then, the steps after a patent has been obtained, are those which the UPR strives to achieve (Escalona, 2015). These include the licenses, *Small Business Innovation Research* (SBIR) startups, new products, economic growth, new jobs, and more in tax revenue steps. If they were fulfilled, it would be full ecosystem circle in which the UPR would thrive (Escalona, 2015). Figure 4 shows four different sources of funding for research, federal funding is usually one of the most used. According to John Hopkins University, "grants, cooperative agreements and contracts are the most commonly used instruments through which the University accepts sponsored federal funding" (John Hopkins University Research Administration, 2017). There are differences between those three forms of federal government awards; for a grant there is usually not much involvement with who awards the funds (John Hopkins University Research Administration, 2017). In a cooperative agreement

there are also funds granted, this with certain restrictions such as the involvement of the benefactor. The degree of involvement should be explained in the terms of agreement (John Hopkins University Research Administration, 2017). Lastly, a federal contract is “usually subject to a strict set of terms and conditions, including clauses that usually require a high level of responsibility to the sponsor” (Purdue University, 2015, p. 2).



**Figure 4:** Stages of UPR Technology Transfer from Research Support to Economic Growth by Dr. Gladys Escalona DeMotta for Federal Grants and Contracts Training Summit Puerto Rico (Escalona, 2015).

As stated by Escalona, “nowadays the UPR is looking to have the same success in publications and funding sourcing to the commercialization area”, they have a clear vision of its role as an entrepreneurial innovation hub for Puerto Rico through *technology transfer and commercialization* (TT&C) initiatives (2015, p. 8). Efforts towards change can also be seen through the disposition of local entities and Puerto Rico public policy changes, in promoting research, IP development, IP protection, IP commercialization, and *technology transfer* (TT). To attend and improve the quantity of IP protection on the Island, and acting as a UPR partner, the *Puerto Rico Science, Technology and Research Trust* created the *Technology Transfer Office* (PRST-TTO). This office was created to promote traffic for commercialization of local scientific inventions (Puerto Rico Science, Technology & Research Trust Technology Transfer Office, 2017). Likewise, the *University of Puerto Rico in Mayagüez* (UPRM) R&D Center created in 2009 the UPRM’s *Intellectual Property and Technology Transfer Office* (IP&TTO) with the mission of “promoting and facilitating academic investigation for new products or services for the economic and social benefit of Puerto Rico assisting the UPRM researchers to commercialize their technologies to support economic development” (University of Puerto Rico at Mayaguez,

2009, p. 1). Also, as a means of encouraging innovation projects, to enable UPR academics interactions in the common marketplace, Law 150 of 2010 was enacted as an amendment to the Government Ethics Law of 1985, which now promotes the participation of academics, professors and researchers from the UPR in IP development and TT (Escalona, 2015).

## **2.2 Business Model Canvas**

### **2.2.1 Business Models and Business Model Canvas.**

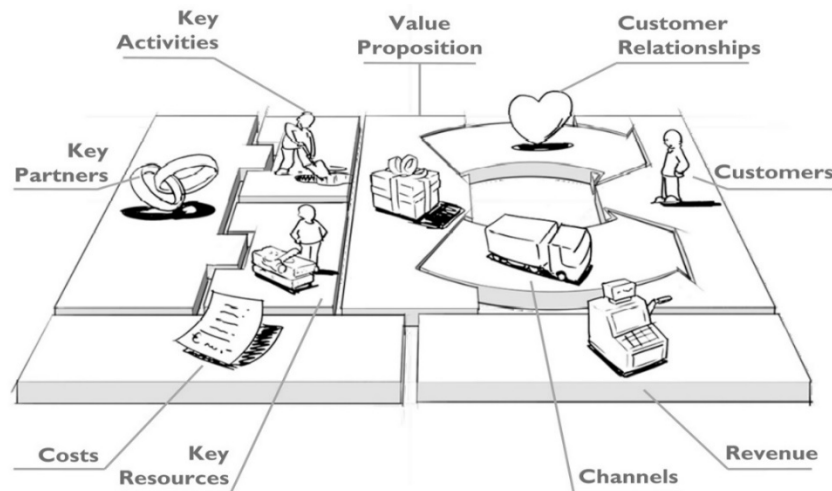
According to Allen (2010), a business model is “how the business will create and capture value for the customer, how the business will generate money” (p. 45). The purpose of a business model is to be an instrument to connect the breach among strategy and business processes (Osterwalder & Pigneur, 2002). Strategy refers to the objectives and goals of the organization and business processes are the tools for execution to implement so that the objectives and goals will be satisfied, there is usually “quite a substantial gap between these two worlds” (Osterwalder & Pigneur, 2002, p.77).

The *Business Model Canvas* (BMC) is a method for analyzing and planning the management of a business in an organized and visual way (Hanshaw & Osterwalder, 2015). It is a methodology used to develop alternative business models adaptable to many kinds of businesses, used by many international corporations, as well as being adopted by universities (Hanshaw & Osterwalder, 2015).

The BMC encompasses the “four main areas of a business: customer, offering, infrastructure, and financial viability” (Osterwalder & Pigneur, 2010, p. 15). The customer section includes the Customer Segment, Customer Relationships, and Distribution Channels; the offering section includes the Value Proposition; the infrastructure section includes the Key Partners, Key Activities, and Key Resources; and the financial viability section includes the Cost Structure and the Revenue Streams (Belmejdoub, 2016, pp. 6-8). These constitute the nine essential building blocks of the BMC.

A visual representation of the canvas is shown in Figure 5. This canvas divides the nine building blocks in two ways; the right side shows the value part of the organization, and the left side of the canvas measures the efficiency of the organization in its ecosystem (Osterwalder &

Pigneur, 2010). According to the creators just by having a glimpse at the canvas, an analysis can be made through visual representation to whether the organization lacks value or efficiency. Figure 6 shows the flow of a BMC layout.



**Figure 5:** Value and Efficiency Business Model Canvas retrieved from (Osterwalder & Pigneur, 2010, pp. 18-19)

The Business Model Canvas				
Team or Company Name:			Date: / /	
8. Key Partners	7. Key Activities	2. Value Proposition	4. Customer Relationships	1. Customer Segments
	6. Key Resources		3. Channels	
9. Cost Structure		5. Revenue Streams		

**Figure 6:** BMC layout (Osterwalder & Pigneur, 2010, p. 44).

The logic of the BMC follows an order within the nine building blocks; customer segments, value proposition, distribution channels, customer relationships, revenue streams, key resources, key activities, key partnerships, and cost structure. An organization serves a Customer Segment to solve a problem or need with a Value Proposition delivered through a

specific Channel to establish and maintain Relationships in the hope of Revenues. For this, there are some resources required by doing certain activities from which some are outsourced. The combination will result in the cost structure (Osterwalder & Pigneur, 2010, pp. 16-17).

According to authors Osterwalder and Pigneur, customer segments are the groups for whom value is created (2010). It “defines the different groups of people or organizations an enterprise aims to reach and serve” (p. 20). The value proposition helps to satisfy a customer need, or solve a customer problem, by creating value through offering a product or service for a specific customer segment. Distribution channels portrays how an enterprise finds consumers, it “describes how a company communicates and reaches its customer segments to deliver the value proposition” (p. 26). The customer relations building block refers to the types of interactions the enterprise will settle with each of the customer segments. Revenue streams “represents the cash a company generates from each customer segments” (p. 30). The key resources refers to any essential physical, intellectual, human, or financial asset needed to make the business model work. Key activities to make a business model work will encompass tasks a company must engage to make the business model work. The key partners building block includes the partners and suppliers system benefiting the business model for it to work. The cost structure contains all the costs incurred for the business model to operate. When authors Osterwalder and Pigneur (2010) discuss making the business model work it refers to what is required by the efficiency side building blocks of the canvas to make the value side work. Details about each building block and a BMC guideline appears in Appendix C.

### **2.2.2 The BMC Excels for Developing Business Models.**

In a survey, conducted by Strategyzer, and funded by Business Models, Inc., about why and how organizations around the world are adopting the BMC, authors Hanshaw and Osterwalder (2015) were able to demonstrate that the biggest portion of the users had applied the BMC for the development of entirely new businesses. The survey also demonstrated that many of the multinational corporations which have adopted the BMC are listed at the Fortune 500 and FT Global 500; these include Coca-Cola, Toyota, Panasonic, P&G, among others. Even though these companies are from different industries the flexibility of the BMC has allowed them to use it to their benefit in diverse ways.

The versatility of the BMC can be seen in an exercise of financial projection conducted by Ferreira de Jesus and Mira da Silva (2012) using the canvas purely. This exercise was extended further by Ferreira de Jesus (2012) in a research which ultimately concluded that for a business with a limited budget it is imperative for them to make strategic choices for the most profitable channel or value proposition to ensure a **startup** (Ferreira de Jesus D. M., 2012). The BMC approach will indicate straightforward answers for the most profitable channel (Ferreira de Jesus & Mira da Silva, 2012).

Vedovato (2015) collected data from a field experiment made by the Ca'Foscari University in Venice, Italy, which consisted in three groups; two groups with different visualization strategies and a control group to measure the changing business model needs. The three groups followed by a questionnaire for small and medium-size enterprises. The strategies for the visualization groups were: (1) a classic approach for the visual representation strategy, and (2) the BMC approach of visualizing. Overall, both groups understood the visual representation for the business model better than the control group did the non-visual representation. The BMC approach excelled the classic approach in every subdivision before and after the explanation of the business model (Vedovato, 2015). The BMC is being adopted around the world by corporations and academic entities as an innovative business strategy plan (PR Newswire, 2015).

### **2.2.3 The use of BMC in the context of projects by Universities.**

The University of Alaska in Anchorage conducted a study about a Community-Based Website E-Business with the goal of a potentially sustainable business model. The primary focus of this project was to collect data about the local community which was segregated in a map for other users to see when looking or a specific area or topic (Yen, Drinka, & Kanamori, 2013). After the website was launched (OpenAnchorage.net), the developers of the project encountered a problem which was stated by Yen, Drinka and Kinamori (2013), “what business model or models should be selected to guide this site towards a successful and sustainable implementation” (p. 80). To attend this problem, according to Yen et al. (2013), the University of Alaska in Anchorage conducted a study in which they used “high school students and business major college students

combined with a recruited target group of users as subjects in the experiment”, these both are the information providers and the site users (p. 81).

The third and last phase of the study was to identify potential business models for the website, so they will serve the community and achieve long-term sustainability. Yen et al. presented the project as a business pilot created of the study, in which they adapted the BMC to their needs. After the BMC components for the study were identified the website was launched with a survey that lasted two weeks online. Stated by Yen et al., for this study, it was concluded the usefulness of the BMC “concept in analyzing and communicating the essence of a business as well as predicting the implications of its needed business components” (p. 90).

In a study by Rytönen (2014) at the Aalto University in Finland, campus managers were facing changes in the university such as expansions and shifting courses, programs to online, and new complex demand, so their current management approach was reconsidered. They needed assistance to manage the current space and/or develop new space or campuses. Due to its previous success solving similar business problems, the campus managers decided to conduct a study using the BMC with the purpose of identifying the pros and cons of a business model approach for university campus management. According to Rytönen (2014), “the aim of this conceptual paper is to find out how commonly utilized business modeling tool called the BMC could contribute to university campus management” (p.1).

Author Rytönen (2014) mentioned they used real estate management and business theories to compare the similarities and differences of integrated Corporate Real Estate Management in the university campus and BMC approaches. For the data gathering part, there were 24 participants who went through seven space development workshop projects and their data collection was divided to answer three main questions. Stated by Rytönen, “the research would have an answer: (a) how is the BMC perceived in a spatial development context, (b) how are spaces described through the model, and (c) how should the BMC be developed further for university campus management?” (p. 1).

The result recommended a community-focused approach for developing space in the university (Rytönen, 2014). As a conclusion to the study, author Rytönen found that for this model to be useful for campus managers it would have to be more specific in terms of space



structure for proper values to be measured (2014). The BMC was successfully used for this exercise in Aalto University and recorded by the campus managers for the research.

According to Sonninen (2016), in Finland, a project by the HAAGA-HELIA University of Applied Sciences developed the strategic management plan for a Start-up company. They used the ***Strengths, Weaknesses, Opportunities, and Threats (SWOT)*** matrix model to analyze the company before and after applying the BMC for the strategic management development plan of the start-up company. Here, the SWOT matrix analysis was developed to assess supporting material needed for their BMC. The result of the project was a development plan with steps for the start-up to follow; the company implemented the plan. They used the SWOT matrix model to understand the company and its industry and the BMC to develop the start-up business model in a practical way for the company (Sonninen, 2016).

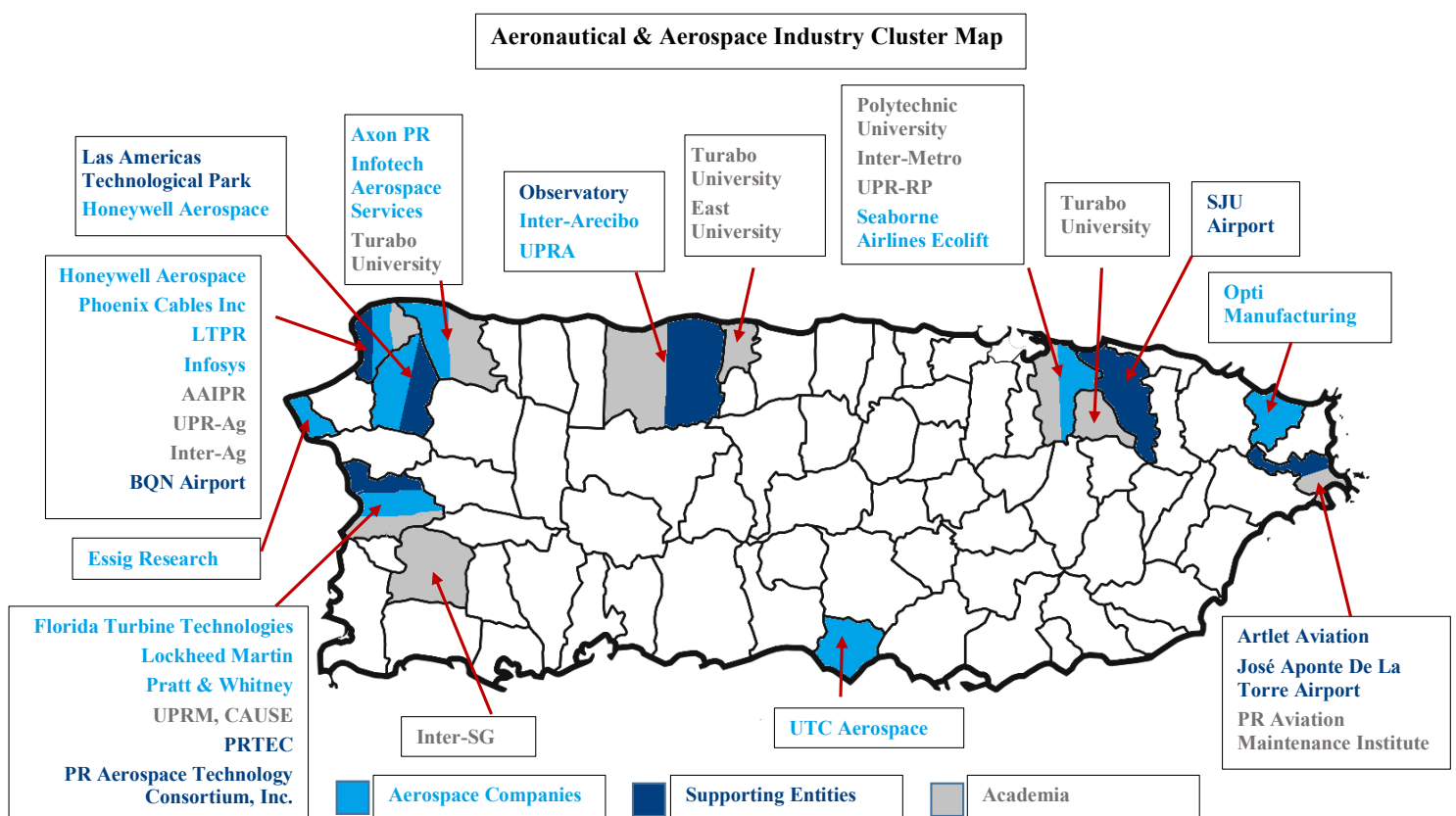
## **2.3 Aeronautical and Aerospace Industry**

### **2.3.1 Puerto Rico Industry**

As mentioned, the AAIPR is an entity that has been funded originally by the Government with the purpose of attending the needs of the growing aeronautical cluster (Commonwealth of Puerto Rico, 2014). Also created in 2014 was the *Center for Aerospace and Unmanned Systems Engineering* (CAUSE) within the UPRM College of Engineering, being a center that provides an “interdisciplinary environment that enables and facilitates participants to carry out collaborative educational and research of a scope and complexity that is not possible through traditional funding” (UPRM College of Engineering, 2018).

In Puerto Rico, the cluster related to the AAIPR is located mostly in the northwest part of the Island comprising various municipalities. Some of the companies related to the aeronautics cluster are Lufthansa Technik, Axon PR, Honeywell, InfoTech Aerospace Services, Infosys Inc., Pratt & Whitney, Lockheed Martin, among others (Puerto Rico Technoeconomic Corridor, 2015). Supporting entities such as the *Puerto Rico Aerospace Technology Consortium, Inc.* (PRATC) serve as a bridge to “integrate aerospace manufacturers, providers and related institutions to develop strategies and foster synergies that will enhance the business environment in the areas where cluster members conduct their operations” (Negron, 2015). Another local supporting entity is the *Puerto Rico Techno-Economic Corridor* (PRTEC) being a non-profit

organization which provides services of business development, project management, landing site and incubation having various types of facilities under (PRTEC , 2017). Their achievements under the Aerospace & Information Technology include establishing six companies. For which four of those started in their current main facilities, the other two in landing sites companies. These companies include InfoTech Aerospace Services, Honeywell Aerospace, Lockheed Martin, Essig Research, and Florida Turbine Technologies and have created over 2,000 jobs between them (PRTEC, 2018). These companies are intertwined and led by the aerospace sector which nourishes from various industries in the area. Such entities also include the academic sector and support service manufacturing which makes it a complete ecosystem (Puerto Rico Industrial Development Company, 2015). A map of the *aeronautical and aerospace industry cluster* (AAIC) containing the companies, pertinent academia, and related supporting entities or facilities are shown in Figure 7.



**Figure 7:** Map includes companies, pertinent universities and supporting entities. Modified updated map from (Puerto Rico Industrial Development Company, 2016).

According to Mislá (2015), “the Island has a unique combination of economic incentives, geographic location, regulatory framework, engineering expertise and a vast manufacturing base that make it an ideal place for the runaway growth of the industry. Among the myriad opportunities in aerospace, three stand out: commercial aviation and defense, spaceflight and cybersecurity” (p. 15).

In the aerospace commercial aviation sector, *maintenance, repair, and overhaul* (MRO) training are already in place at the AAIPR, see Appendix B for more data on MRO training in the AAIPR. The U.S. aerospace defense subsector had forecasted the most growth globally for the year 2017 at 3.2% and is expected to continue to increase under the current administration (Deloitte, 2017). According to the U.S. Department of State, all the federal defense technology must be produced by U.S. citizens under U.S. exports under the International Traffic in Arms Regulation (U.S. Department of State, 1996). This regulation has a few exceptions for some foreign countries, but Puerto Rico, Guam, and other U.S. territories are considered local in this category and could benefit from the expected growth in the aerospace defense subsector. Regarding the aerospace spaceflight sector, fruitless attempts for big scale development have been made; in 2016, there was a brief submitted to the *Puerto Rico Oversight, Management, and Economic Stability Act* (PROMESA) to build a Spaceport in Puerto Rico with an estimated economic impact of over \$197 million for the following 10 years (SPACEINNOVA LLC, 2016). As of 2015, the AAIC in Puerto Rico provided around 5,000 jobs but, it is expected to grow around up to 3,000 more jobs from 2015 through 2018 (Mislá, 2015).

As a general industrial incentive, Act No. 73 of 2008, known as the Economic Incentives Act for the Development of Puerto Rico, offers tax credits of up to \$5,000 for the creation of jobs and up to 50% of expenses incurred for the R&D activities the entity does (Department of the Economic Development & Commerce, 2015). As a Government incentive for this specific industrial cluster, as mentioned in the EY Americas Tax Center report, Act No. 32 of 2014 is an addition of the Act No. 73 of 2008 to provide exemptions to maintenance, repair, and overhaul (MRO) and related activities with incentives such as 4% flat tax rate, 100% exemption from tollgate taxes, 60% exemption from municipal taxes, and 90% exemption from property taxes (EY Americas Tax Center, 2014). Because Act No. 73 of 2008 was focused to the manufacturing industry, Act No. 20 of 2012 was developed to attract companies focused to

Promote the Exportation of Services (Department of Economic Development & Commerce, 2012b). This act includes incentives such as 4% fixed income tax rate which could be reduced up to 3%, 100% exemption of dividends or profit distribution, and zero contributions on the U.S. for exportation services on R&D, consultancy, professional services, centralized management services, among others (as cited in Department of Economic Development & Commerce, 2012a). Another Act which could apply is the Individual Investors Act No. 22 of 2012 for bona-fide residents of Puerto Rico on qualified investments which includes 100% tax exemption from Puerto Rico income taxes on all dividends, interests, short-term or long-term capital gains accrued (Sotheby's International Realty, 2017). According to economic progress report for the aeronautics industry “exports have the potential to improve Puerto Rico’s fiscal and financial crisis since they respond to external demand” (Banco Popular de Puerto Rico, 2016) .

These kinds of incentives are given so existing companies would expand, or new companies would establish in the Island (Misla, 2015). Misla (2015) states that “Honeywell Aerospace has committed to investing nearly \$30 million to establish an electromagnetic imaging & compatibility and environmental test laboratory” to be located in the facilities of Las Américas Technology Park in the municipality of Moca (p. 16).

### **2.3.2 Global Industry.**

According to the Deloitte Global Aerospace and Defense Sector Outlook of 2017, the global aerospace industry has had multiple consecutive years of growth. The aircraft production global demand is estimated to be 35,155 new aircrafts for the year 2035, that is at least a 29.3% growth for the next decade. This increase is primarily driven by global demographics and wealth formation in Asia and the Middle East which are the region’s most significant passenger traffic growth from 2010 through 2016. The commercial aerospace operating earnings were expected to grow 20.6% in 2017 and aircraft backlog orders are approximately 13,500 aircraft units, compared to 10,640 in 2013, which represents almost a 10-year backlog orders for future production (Deloitte, 2015, 2017).

Serving the Asia and Middle East geographical area is Singapore, they have a mixed ecosystem regarding the AAIC including many international companies such as Boeing, Honeywell, Hamilton Sundstrand, Windsor Airmotive, and the support of their government, as

well as, numerous academic entities. The Singapore Institute of Aerospace Engineers has a Professional Development Centre subsidiary, the Air Transport Training College, with various training programs, certifications and bachelor's degrees, parallel to the *Aeronautical and Aerospace Center for Service Training* (AACST) division of the AAIPR. This training college is much more developed in its academic offerings since it was created in 1999 to satisfy its industry cluster (Singapore Institute of Aerospace Engineers, 2016).

Also, comparable to the proposed *Aeronautical and Aerospace Institute of Multidisciplinary Technologies* (AAIMT) division, in 2012 the Nanyang Technological University in Singapore paired with the Civil Aviation Authority of Singapore Government entity to create an R&D Institute dedicated to air traffic management. The Air Traffic Management Research Institute was provided with \$36.5 million by the Civil Aviation Authority of Singapore to fund R&D activities for research projects. Meanwhile, the Nanyang Technological University contributed \$16 million worth towards facilities and researchers (Civil Aviation Authority of Singapore, 2012).

Several sources (British Chamber of Commerce, 2014; Francis, 2015; Ng et al. 2012) affirm Singapore has become an aerospace and MRO hub for its geographical area. The U.S. Department of Commerce emphasizes this is due to Singapore government MRO initiatives during the late 90's (Ng, Ndengabaganizi, & Shiou, 2012). These initiatives prove to be successful in the airshow of 2014 for which they attracted exhibitors from 47 different countries (British Chamber of Commerce, 2014). To maintain competitiveness, the A\*Singapore Agency for Science, Technology, and Research partnered in 2014 with the aerospace industry to strengthen the MROs services and through investments in research of science and engineer create new products (Singapore Agency for Science, Technology and Research, 2014). Also, Singapore Technologies Aerospace is now “expanding its passenger-to-freighter conversion” operations within MRO to appeal to “less price-sensitive” markets (Francis, 2015, p. 3). In Singapore, the services seem to be scattered throughout different entities across the country, as in PR those same services are to be provided by the AAIPR proposed divisions.

Also proving diversification as a geographical aerospace hub, the British Chamber of Commerce (2014) states that “Singapore is fast establishing itself as an R&D hub. Besides the

increasing aerospace R&D efforts driven by public-funded research institutes and universities, aerospace companies' in-house R&D footprint has also grown with the increase in manufacturing activities" (British Chamber of Commerce, 2014, par.18).

According to a survey by the KPMG auditing company, "the next few years will usher in an era of collaboration around products and services, R&D, and access to markets that will fundamentally change the way aerospace and defense organizations operate" (KPMG, 2014, p. 2). This survey suggests that to increase opportunities, reduce costs, and improve revenues the aerospace and defense organizations are branching to other markets through partnering and investing more revenue in R&D to boost innovation (KPMG, 2014). These partnering, or collaborations, are already taking place, the College of Aviation Technology in Ireland, offers graduate and undergraduate intensive programs in various engineering majors regarding aerospace, they have also partnered with Lufthansa to offer MRO related programs under the EASA curriculum, this academic offering compliments what it is offered in the AAIPR for Lufthansa (College of Aviation Technology, 2016). Organizations who also want more opportunities branch to other markets and sometimes benefit from incentives other countries offer. For example, Ireland offers R&D incentives including all the expenses for the year incurred, facilities credit up to 25% of the costs incurred in R&D buildings and grants are also offered (Deloitte, 2014). If some company subcontracted another for the R&D activities credit is up to 15%, for a university is 5%, of all expenditures, is given to one of them if the total amount is €100K (Deloitte, 2014). Also, according to PricewaterhouseCooper Global R&D Incentives Group (2014), "excess credits may be refunded or carried forward indefinitely" (p.19). Some of the beneficiaries of this incentives are those identified in the Aerospace Ireland Directory as aerospace R&D related facilities which include 16 facilities among companies, universities, and institutes (Enterprise Ireland, 2013, pp. 110-125).

The AAIPR is expected to become aerospace industry hub to this side of the globe having mentioned respective geographical hubs such as Singapore serving Asia and the Middle East, and Ireland serving Europe (Arroyo, 2016b). The continuous and expected growth of the aerospace industry along with the mentioned forecasted collaborative industry shift are some positive indicators which encourage the Institute to keep striving towards global competitiveness.

### 3. METHODOLOGY

#### 3.1 Methodology Tool

This study utilizes qualitative research as the methodology tool used. **Qualitative research** encompasses the gathering, “analysis, and interpretation of data that are not easily reduced to numbers” (Anderson, 2010, p. 1). It is described as “uniquely suited to uncovering the unexpected and exploring new avenues” (Marshall & Rossman, 2006, p. 38). It is recommended to be used to interpret a phenomenon “involving asking participants about their experiences” (Austin & Sutton, 2014, p. 436).

The advantages of using the qualitative research method are the detail and depth of the data gathered can be quick for revision to add new information, “findings can be transferred to another setting” (Anderson, 2010, p. 2). Some drawbacks of the qualitative research method are the possible personal biases from the researcher or participant-interviewee, “the volume of the data makes analysis and interpretation time consuming,” findings can be difficult “to characterize in a visual way” (Anderson, 2010, pp. 2,3). It is appropriate to utilize this method for this study because to successfully develop a *Business Model Canvas* (BMC) for a *University of Puerto Rico* (UPR) corporate subsidiary in the aerospace sector, there needs to be particular data gathered from expert sources.

Semi-structured interviews were chosen as the means to gather data, rather than a standardized comparison as it allows more in-depth data and the participants-interviewees can share their experience with the theme. This allowed a more thorough study analysis. There were twelve semi-structured interviews performed for this study. After this, a qualitative analysis was made using the inductive analytic approach. The **inductive approach** “allows for codes, themes, and ideas to arise from the narrative – but nevertheless starts with some priori hypotheses and perspectives” (Choo, et al., 2015, p. 1106).

#### 3.2 Methodology Process

Initially, a discussion was held with the *Aeronautical and Aerospace Institute of Puerto Rico* (AAIPR) management to assert the Institute goals for the *Aeronautical and Aerospace Institute of Multidisciplinary Technologies* (AAIMT or Division) to undertake the project. This

discussion included an overall description of the AAIPR current offerings, the explanation of other projected divisions, and their expected interactions with the industry once all of them are completed. At this, the AAIPR management determined the focused of the project to be for the AAIMT projected division, given the expected significant impact it will have on the Island economy. The projected offering, purpose, goals, and target segments of the AAIMT were also discussed.

The management of the AAIPR favored the situation when an entity would sponsor a project considering it would enable quicker commercialization of the technology to then obtain the royalties of such. This, under the impression that if an entity funds a project, the Division would have agreements with the funding party for the IP development, protection, and commercialization of the technology produced. Here, the management of the division was anticipating that the commercializable material produced would be best if managed by the funding party and the Division receive certain royalties or licensing proceeds. Therefore, the first segment identified was a project sponsored by an entity. Nevertheless, the management of the Institute wanted to explore if there were options available for a project by a UPR researcher, which avoided or reduced the risk of compromise in sharing or conceding ownership, licensing, or royalties of IP produced to a sponsor party. Pursuing this goal, the project by the UPR researcher identified segment was divided in two other segments. One as being sponsored by federal, UPR, local government, or public funds and the other as being sponsored by any other type of funds.

Following the conversation with the AAIPR management, it was determined to explore further the topics addressed to find ways to depict the AAIMT division considering the management needs and goals. The identified three target segments by management were used to develop the main objective and scope of the project.

The main objective of this project is to provide alternative business models for the three primary target segments identified by the AAIMT management. The methodology used for this applied qualitative research project encompassed means to explore, explain, and describe utilizing primary and secondary data on topics such as the aerospace industry, the UPR,



*technology transfer and commercialization* (TT&C) of inventions, the AAIPR, and tools like the BMC and the *Strength, Weakness, Opportunities, Threats* (SWOT) matrix.

The management showed they used parts of the BMC as a visual and quick tool for analyzing the AAIPR. This tool helped assess the Division internal and external capabilities. Though the BMC has been used by universities to create business models for private companies, evaluate businesses for class purposes or make in-campus assessments, there was no documentation found of the BMC been used in an academic scope such as the one presented by the AAIMT Division. The BMC is a tool that has worked for a wide range of businesses; it can be used to map out the strategic planning options, their impact, and interdependence. Due to the versatility and the management familiarity with the tool, the BMC was chosen to portray the AAIMT division as an alternative business model analyses.

### **3.3 Methodology Steps**

To undertake this applied qualitative research project, the next steps were followed to assert the project objective.

Information was gathered on the Institute, the UPR commercialization process with applicable policies concerning *intellectual property* (IP) protection and the *technology transfer* (TT) process, the *aeronautical and aerospace industry cluster* (AAIC) in Puerto Rico and globally and applicable tax incentives or exemptions, and the applicability of the BMC tool for this project. The SWOT matrix was chosen as a strategic planning tool for the evaluation of the AAIMT as a whole before focusing on each target market helping assess the current or projected situation of the Division for strategic options.

Interviews were made through open answers questions. The purpose of interviews was to further comprehend topics within the scope of the project for the accurate development of the BMCs. It included topics such as the AAIC, changes in the AAIPR and/or AAIMT the operation or projections, operation of UPR corporate subsidiaries or similar entities, the IP protection and TT development in the UPR, and the BMC tool usefulness. The interviews were made with UPR officials and UPR corporate subsidiaries officials, AAIC experts, university researchers, and professional BMC users, which were the four focus expert areas.

The outlined questions were divided into ten parts representing the nine building blocks of the BMC plus a random questions part. Each section was then subdivided by the focus expert areas because some of the interviewees gave insight in more than one of the focus areas and/or building blocks. This also meant that the interviewee does not participate in all the nine building blocks. There were ten interviews performed in person and two via telephone, totaling twelve interviews of an approximate duration of 30 – 60 minutes each. The UPRM International Review Board authorization letter, interview guiding questions document, and the informed participant consent sheet are in Appendix D. The informed participant consent sheet was provided to the interviewee prior to the interview.

After the interviews were conducted, a code book manual was created as a mean of organizing statements and themes from the interviewees. A **code** is “a descriptive construct designed by the researcher to capture the primary content or essence of the data” (Theron, 2015, p. 5). Charmaz mentions it serves as a “link between data collection and explaining the meaning of the data” (as stated in Theron, 2015). The codes used were based on the literature review main topics. They were used as a way of categorizing the data obtained from the interview into themes following the BMC building blocks in order to make the analysis. To see more information regarding the code book manual, refer to Appendix E.

These codes were identified applying the BMC literature review to the objective of the AAIMT using the information provided by the management of the institute and the literature review data collected about the UPR, AAIPR/AAIMT, and AAIC. The interview data recollected was classified by common themes or similar statements and then organized among the BMC building blocks.

Hanshaw and Osterwalder mention the adaptability of the BMC tool as it has been applied to multinational corporations from different industries (2005). The versatility of the tool can be seen from a financial projection Ferreira de Jesus and Mira da Silva made using purely the canvas (2012). The application of the BMC tool in the university context can be seen in projects such as the Community-Based Website E-Business from the University of Alaska in Anchorage which used the BMC prior to launching the business as an analyzing tool to identify the viability of a long-term sustainable business model (Yen, Drinka, & Kanamori, 2013). Also, two different universities from Finland had projects in which the BMC was used as a business

modeling tool who contributed to the university campus management and for a university start-up business model (Rytönen, 2014; Sonninen, 2016).

Regarding the building blocks, authors Osterwalder and Pigneur portray in their book, *Business Model Generation*, guidelines and examples of how to develop each building block for any particular business (2010).

Customer segments are the groups for whom value is created (Osterwalder & Pigneur, 2010). It “defines the different groups of people or organizations an enterprise aims to reach and serve” (Osterwalder & Pigneur, 2010, p. 20). The AAIMT executive director identified the development of projects by the corporate/private sector or by university researchers as the main groups who they want to serve (Arroyo, 2017).

The value proposition helps to satisfy a customer need, or solve a customer problem, by creating value through offering a product or service for a specific customer segment (Osterwalder & Pigneur, 2010). According to the AAIPR Strategic Development Overview, the Division will providing services of “R&D, IP development, and a TT&C platform” (Arroyo, 2015a, p. 1). The division aims to provide those services to cater to the aerospace ecosystem needs as they will be the only center in Puerto Rico and the Caribbean with the capabilities to do so (Misla, 2015).

Distribution channels portrays how an enterprise finds consumers, it “describes how a company communicates and reaches its customer segments to deliver the value proposition” (Osterwalder & Pigneur, 2010, p. 26). As a way of reaching the customer segment to communicate the value proposition, in 2016 the AAIPR was participant of the Hannover Messe 2016 industrial fair in Germany, presenting the AAIMT division (Hannover Messe Worldwide, 2016). They have also “been part of the Department of Commerce Select USA program” to attract investors (Arroyo, 2016, p. 42).

The customer relations building block refers to the types of interactions the enterprise will settle with each of the customer segments (Osterwalder & Pigneur, 2010). Interactions with the customer segment will depend upon the type of service the AAIMT provides to them. The intricate service training agreements the AAIPR currently has with Lufthansa Technik and

Honeywell serves as a tailored relationship between the two entities (Arroyo, 2015b; Mislá 2015).

Revenue streams “represents the cash a company generates from each customer segments” (Osterwalder & Pigneur, 2010, p. 30). The PRST-TTO was created to promote traffic for commercialization of local scientific inventions (Puerto Rico Science, Technology & Research Trust Technology Transfer Office, 2017). The AAIMT aims to make or facilitate the customer segment the complete process, from R&D to commercializing the technology created (Arroyo, 2016).

The key resources refers to any essential physical, intellectual, human, or financial asset needed to make the business model work (Osterwalder & Pigneur, 2010). As stated by Arroyo, this business model will need all of the essential key resources; infrastructure, equipment, funding, researchers, research team, and administrative personnel (Arroyo 2015; 2016).

Key activities to make a business model work will encompass tasks a company must engage to in order operate the enterprise (Osterwalder & Pigneur, 2010). Activities can take many forms such as delivering a product, solving a problem, or offer trainings among others (Osterwalder & Pigneur, 2010).

The key partners building block includes the partners and suppliers system benefiting the business model (Osterwalder & Pigneur, 2010). Here would lie any kind of affiliation the AAIMT would have with an entity, such as the organic relation the AAIPR has with the UPR or the AAIC industry (Arroyo, 2016).

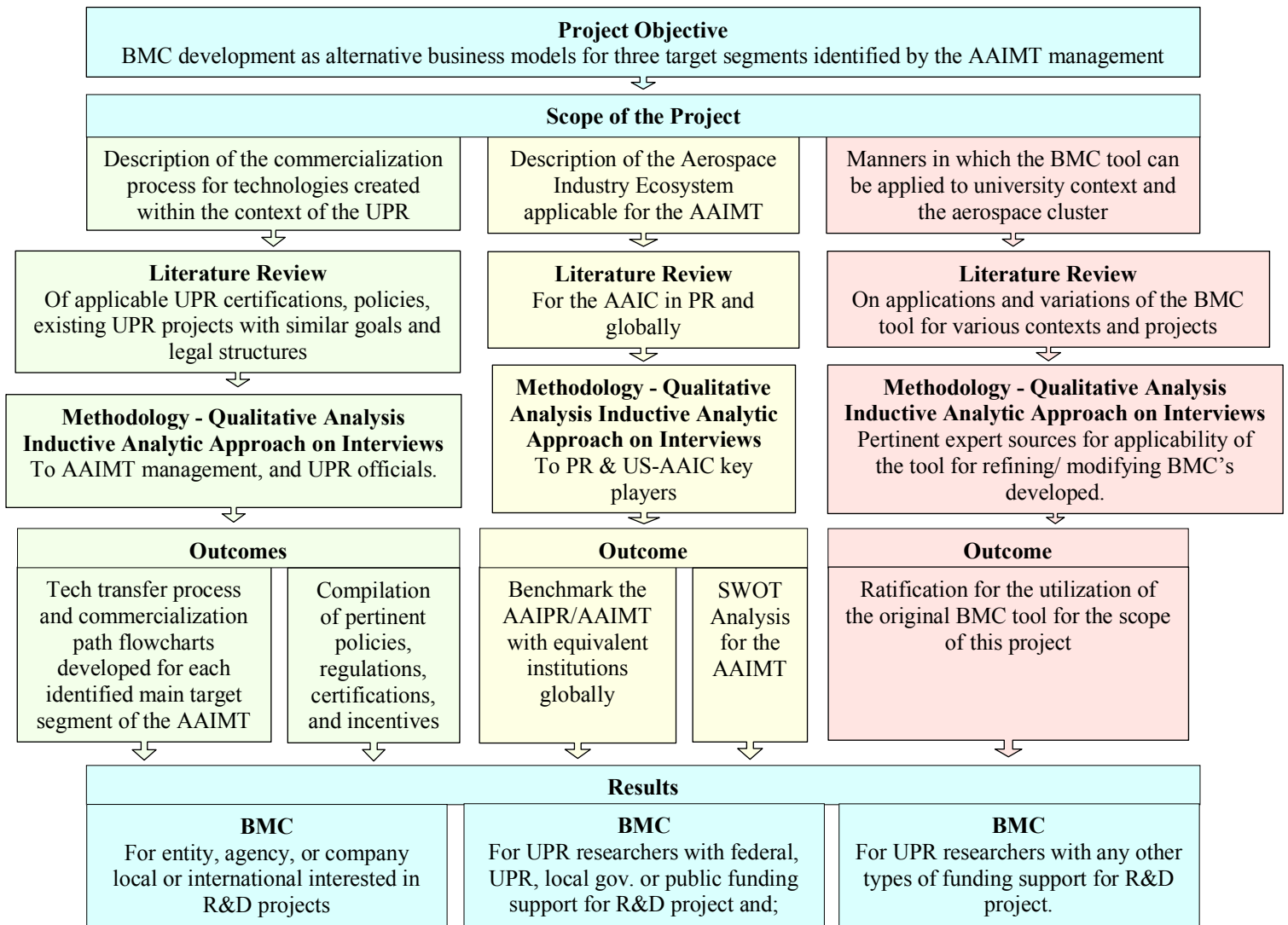
The cost structure contains all the costs incurred for the business model to operate (Osterwalder & Pigneur, 2010). These will include the expenses to be able to offer the value proposition, expenses related to key resources or activities, and any other underlying cost that could arise from operations (Osterwalder & Pigneur, 2010).

The next step was the development of the BMCs. The main target segment identified by the AAIPR management were innovators with commercialization goals encompassed in 1) an entity, agency, or company local or international interested in R&D projects; 2) a UPR

**researchers or inventors** with federal, UPR, and/or public funding support for R&D project; and 3) a UPR researchers with any type of funding for R&D project.

There were additional relevant factors emerging from the analysis process. These include: a) a TT Process and Commercialization Path Flowcharts for the AAIMT; b) a compilation of pertinent policies, regulations, and incentives; c) an AAIPR or AAIMT equivalent global benchmark description; d) a SWOT matrix analysis for supporting material to assess the evaluation of external and internal factors for the AAIMT division; e) and the validation for the utilization of the original BMC tool for the scope of this project.

The Objective Process Diagram from Figure 8 summarizes the methodology steps used for this project.



**Figure 8:** AAIMT Project Objective Process Diagram Copyright © Edmée M. Cortés Valle, 2018.

## 4. ANALYSIS AND RESULTS

There were twelve interviews performed, two of those via telephone, the other ten in person. The interviews were made to *University of Puerto Rico* (UPR) officials and UPR corporate subsidiaries officials, *aeronautical and aerospace industry cluster* (AAIC) experts, university researchers, and professional *Business Model Canvas* (BMC) users, which were the four focus expert areas. Notes were taken and transcribed; a qualitative analysis was made using the inductive analytic approach. The transcriptions of the interviews were then organized by themes following the BMC building blocks and other recurrent remarks as a guide making this the coding format order. For details on the code book manual refer to Appendix E. The purpose of this qualitative analysis was to gather data from experts in the areas needed for the development of the business models using the BMC as the topic layout for the interviews. The name of the interviewee is omitted for privacy reasons, interviews are identified by an encapsulate capitalized letter. The professional occupation of the interviewees with its identification letter is mention in Appendix D along with the guiding questions for the interviews.

### 4.1 BMC tool and its Building Blocks Analysis

#### 4.1.1 BMC Tool

In the coding process there was a variety of themes identified. Some of the remarks by the interviewees could fall under one or more of the themes identified in the coding process. Regarding the BMC tool, the themes that arose include the use, adaptability, and versatility of the BMC.

Interviewees [J] and [I] mention their constant use of the BMC tool, as a successful part of the coursework they assign as professors, this for its adaptability to analyze businesses and create alternatives for such. Regarding the adaptability of the tool, interviewee [I] admitted to making changes in the BMC layout to fit a particular need for certain projects. “For course teaching purposes I swap the distribution channels and customer relationship blocks for a competitive analysis, as well as complementing the BMC with analysis such as SWOT”. Ten of

the twelve interviewees admitted have heard or seen the BMC tool, eight of those concurred “to have used the BMC in the past”.

#### **4.1.2 BMC Building Blocks.**

**Customer Segments.** Themes identified to be related to the different groups of customers include; types of projects, length of projects, scenarios of possible projects or subdivisions,

Regarding the scenarios of possible projects or subdivisions many variations were mentioned. These pertaining corporations/agencies and university researchers, the groups for whom value is being created. Interviewee [A] mentioned variations of what the customer segment would want to point that “some corporations might only need AAIMT to finish a project, or use the facilities, an equipment, the researchers, even all the services”. Related, [B], [C], [E], and [K] also mentioned types of projects and companies who have started or made projects in a similar setting, such as the landing of Infotech in Puerto Rico, sponsoring of projects or graduate students by NASA.

A reoccurring theme mentioned was the difficulty to obtain funds for projects in general, this was mentioned by eight of the twelve interviewees. The interviewees [A], [F], [G], [H], and [L] concurred about the long process a federal grant for funding requires. [B], [C], [G], [H], [I], and [K] mentioned the researchers are usually the who will reach the industry to pitch an idea for a project sponsorship because the UPR is not effective encouraging this type of relation.

Another concept also highlighted was the typical duration of projects. [D], [F], [G], [H], and [I], was mentioned that federal, public, or university funded projects tend to be longer than private or corporate funded projects. [G] said, “in a federally funded project the length of the project is usually from one to five years”. [H] also mentioned benefits of a private/corporate funded project as “being a more rigorous project, especially with deadlines, as the funds are usually given for a specific amount of time, usually up to one year which is shorter timeframe compared to a federal or university funded project”.

Interviewees [B], [C], [I], [J], and [K] coincided in a general recommendation for the AAIMT to concentrate. Regarding the type of project to pursue in short term, they agreed the

best turnover for the division would be to pursue projects funded by corporations. This related to the project length and faster funding approval in comparison with those federally funded.

**Value Proposition.** The subjects identified involving the creation of value encompassed themes included in the services offering and added value factors. The services offering is the bundle of products. The interviewees highlighted more the added value factors rather than the actual service offering. Added value factors mentioned included; location, compliance with aerospace regulations, federal and local incentives, beneficial regulations, UPR sought engineers and STEM students.

Regarding the services the AAIMT proposes to provide, the interviewees [A], [B], [C], [F], [G], and [H] responded most hesitant towards the TT&C component, followed by the IP development component. Interviewees [A] and [B] agreed that “current UPR policies would make challenging the TT&C and IP development”. Additionally, interviewee [A] and [J] mention “the Division best course will be to focus in the R&D component and cover what the project sponsor expects until UPR policies change”. Highlighted by interviewee [C] was the history of the industry commenting on “offering whole package services such as space for rent, help with engineer recruiting, incentives, and suppliers for companies starting presence in the Island”. Alas, [C] also added that “there has not been a new aeronautical company with these characteristics developed in Puerto Rico in the last ten years”. Interviewee [I] emphasized that “acting as an incubator for companies or start-ups is already a capped market”. Nevertheless, mentioned by [B], [C], [E], and [K] was the advantage of the AAIPR currently focusing more on technical trainings which would position the AAIMT in better standing at the AAIC due to this not being common.

Concerning the research clusters identified by management, interviewees [D], [F], and [K] agreed some of those clusters have been proved to be emerging ones for the future. From those clusters interviewee [D] gave insight in Navigational & Positional Technologies and Space Vehicles, [F] in Atmospheric Sciences, and [K] in Unmanned Aerial and Space Vehicles.

As for the added value factors, pertaining the location of the Institute, interviewees [B], [C], and [K] mentioned they are located in a perfect spot, close to engineering students in the UPRM and to the AAIC. Interviewees [B], [D], [F], [K], and [L] also recognized the g



geographical location as an advantage. This being a “middle point between continents” in a “stable weather environment, great site for potential launching”. Although, researchers [E], [F], [G], [H], [I], [J], and [K] expressed they will need a greater motivation than providing R&D services. For them to locate there for a project, motivation such as, “a special laboratory, equipment, and flexible hours for access to the work team”.

Another added value factors are the compliance with aviation regulations, federal and local incentives and beneficial regulations. Interviewee [E] mentioned as value, the compliance with both EASA and FAA regulations. “This enables local and foreign companies, or federal agencies to have the benefit of complying with both”. Mentioned by ten of the twelve interviewees was the potential for incentives or policies the AAIMT could benefit from. Although, the only specific incentives mentioned were the Economic Incentives Act by [C] and the Intramural Practice Plan by [G]. Interviewee [D] pointed compliance with the *International Traffic in Arms Regulation* (ITAR). The AAIMT would fall under the Air Defense category – R&D and IP development service provider, “this regulation requires all defense related activity be done by U.S. Citizens”.

Other remark mentioned by [D], [F], and [L] in relation to the value of the AAIMT is regarding the considerably inexpensive professional services the overall Island offers in comparison with continental U.S. Interviewee [L] stated, “in Puerto Rico there are well trained engineers for a fraction of what it would cost a company in the U.S. or Europe”. Also, mentioned by nine of the twelve interviewees was the constant sought by scouts to employ UPR students in STEM, making remarks on the engineers.

The current AAIPR offering was also considered by interviewees as strong complementing services. Interviewee [K] stated, “their academic offering is aligned with technical trainings for the industry, with modifications, it can be adapted to engineering curriculums in UPRM incorporating their hangar as a training laboratory”.

**Distribution Channels.** The topics identified concerning the means of attracting the companies and/or researchers to announce the AAIMT and their proposed offerings included; reaching out to the industry, local players, and the academia.

Regarding reaching out to the industry, interviewee [K] mention the importance of “fostering collaborations with the industry as well as other local players, not necessarily of the AAIC, this to assess the needs of such industry and ecosystem”. Another mention was from interviewee [D] who emphasized on a global AAIC stating possible collaborations being made with outside entities.

Concerning the academia, themes such as collaborations involving researchers or students and publication of research results arose. About collaborations involving researchers and students, interviewee [G] mentioned the “informing a faculty or group of students about a potential research project in a specific field always draws attention and usually a researcher (or student) ends up becoming part of such. Interviewee [H] states that from a researchers’ perspective, the motivation for a research is publication because “displaying the research in a journal or a conference gives it exposure to the industry and this exposure may generate further interest from future sponsors”.

**Customer Relationships.** Themes identified concerning the type of relationship the Division would establish with a company and/or researcher include those related to dedicated personal assistance and co-creations. Involving the dedicated personal assistance topic there are examples and recommendations of tailored relations provided by interviewees [C], [G], [H], [I], and [K]. These include topics of assistance and flexibility for the customer.

Regarding assistance, interviewee [C] mentioned a model in which the AAIMT could “provide the company the space to work, help recruiting staff and UPR professionals, and with possible incentives”. Interviewee [I] and [K] mentioned a similar model but focusing instead in the researcher, rather than a company.

Concerning flexibility, when the customer is a researcher, interviewees [G] and [H] mention the importance of the communication between the Division, the researcher, and the research team. An example of this given by [H] was “have accord accessibility of the facilities for the research team at any time”.

Involving co-creations, interviewees [A], [B], [F], and [G] mentioned topics related to the development of relation terms such as types of agreements or contracts. Interviewee [A]

mentioned differences between a research, work collaborative agreements, or a licensing agreement. Research collaborative agreement would imply that “the AAIMT is taking part in the research to some degree. Work collaborative agreement, for example, providing only the space to work”. Interviewee [A], [B], and [G] mentioned having a licensing agreement being beneficial when producing IP. They as well mentioned this being “currently subject to UPR policies” and “difficult to realize in a timely manner”. Interviewee [F] compared the relation researchers have with federal agencies, private entities, and the UPR, mentioning that “the expectative guidelines for the project execution, regardless of the outcome, will always be portrayed in some type of agreement”. Similarly, [G] mentioned “cooperative agreements and grants being types of contracts” with similar purposes.

**Revenue Streams.** Regarding the generation of income for sustainability and growth of the Division, topics that arose were related to charging fees for the services to be provided, licensing and royalty fees of long term IP generation, and the impact from the relation of the UPR with the Division.

The possibilities of fees that could be charged for the services to be provided mentioned by eleven of the twelve interviewees included: use of facilities (including laboratories), equipment, researchers, research team. These interviewees concurred these services could be used as a package or individually, depending on the need of the customer. Interviewee [G] stated “if there is a special equipment unique to them and necessary for certain projects researchers would budget to pay for the use of such”. Regarding researchers and the research team, interviewee [H] mentioned that if needed, “a company is willing to pay for specific services or personnel”.

About revenue from licensing and royalty of long-term IP generation, interviewees [A], [B], and [L] concurred it would be the best income generation alternative if possible. Interviewee [L] said “if the technology created and protected is marketable, licensing such would generate income and royalties without having to incur in the product making or commercialization”. With respect to the IP generation, interviewee [A] stated “the only purpose of generating IP should always be to obtain income, preferably by selling it. IPP is not worth it if the innovation is not commercializable”. Interviewee [A] mention the UPR patent net income

distribution policy and suggested flexibility in UPR ownership of IP and a distribution of royalties to be 33% for investors, 5% for UPR Central Administration, 5% for the UPR Campus of the invention, and 57% for the Department in where the invention was made.

Related to the impact from the relation of the UPR with the Division, interviewees [A], [C], [G], [H], and [J] were hesitant about the actual real options the AAIMT could have to undertake this long-term approach. Stated by interviewee [A], “There is an undefined line with regards to the ability of the AAIPR/AAIMT making any type of agreement concerning IP created. If treated like any other UPR owned entity it will follow the normal IPP process within the University”. Providing an example of another UPR corporate subsidiary, interviewee [J] mentions Viride, Inc. as, “a similar example to the AAIPR/AAIMT, who follows the normal University IPP process”. Interviewee [G] observes that a “change is needed towards flexibility regarding the University IP policies to further foment innovation and development in order enrich the ecosystem and grow”.

**Key Resources.** The subjects identified as the most important to make the business model work are included within the four main categories of physical, intellectual, human, and financial resources.

Among the physical resources the themes highlighted were related to the facilities and equipment for laboratories. Remarks were made by interviewees [E], [F], [K], and [L] on the need of facilities, such as laboratories, and their potential practical use for projects. Interviewee [E] mentioned opportunities of collaboration between the Division, academic research sector, and the industry due to the “uniqueness of the Institute current and future offerings”. Also associated to the facilities, mentioning the already established hangar of the AAIPR, interviewee [K] stated that “there is a necessity for a fully equipped research laboratory hangar for the academic community in Puerto Rico, especially for engineers in training”.

Inside the intellectual resources set, interviewees [A], [B], and [C] made remarks on topics related such as the potential IP and strategic partnerships. Regarding the potential IP, interviewees [A] and [B] agree with the potential IP produced by the Division being a key resource to make the business model work “to attract investors or collaborators who would want or need said IP” stated [B]. About strategic partnership being a key resource, it would depend of

the kind of partnership. For example, interviewee [C] mentions the current relations the AAIPR has with Lufthansa Technik and Honeywell “as a key resource partnering because due to such the Institute is now involved in special unique trainings which would not have happened otherwise”.

Within the human resources category, the themes highlighted were related to the importance of the researchers, research team, and the need for an operational staff. The first two aforementioned were indicated as being the most important resource to make the business model work by interviewees [F], [G], [H], [I], and [K]. It was specially remarked by interviewees [F], [G], and [H], as a first priority, the availability of researchers and a research team. Regarding the research team as a resource interviewee [H] stated “the most effective way to gather a research team for a project is using graduate and undergraduate students for such”. After facilities, researchers, and research team were mentioned, interviewees [I] and [K] commented the operational staff of the laboratories or Division followed in importance among the resources needed for a project to take place.

Between the physical and human resources, it was mentioned the potential motivation to researchers for moving partial work space to use the services offered. Interviewee [C] mentioned that “for the researchers to move to Aguadilla there needs to be a major motivation, not only the promise of a work space”. Interviewees [G] and [H] agreed on moving if the AAIMT would have some type of specialized equipment or laboratory needed. Also pointed by interviewee [H] as a motivation for moving a research is “the interaction with the industry for potential collaborations, this due to the Division and to the location of it”.

Among the financial resources needed to make the business model work, the topics identified were funding options for internal research projects, and funding options for projects from the identified customer segments. In regard to the funding options for internal research projects, mentioned by interviewee [G] was the ability to “apply for different types research grants given their expertise aim”. Related to the options for federal funds, interviewee [G] also mentioned that “there are some different types of federal funding awards, not only grants”. For funding options for the projects from the identified customer segments, a key financial resource

mentioned by interviewee [C] was the existent relation with the industry which “will attract AAIC members to use the facilities and services”.

Relating to both physical and financial resources, interviewees [C] and [K] mentioned the \$4.6 million EDA grant made towards the rehabilitation of adjacent buildings for the research component of the Institute. Interviewee [C] stated that “the Federal government has been committed to support this (aeronautical) industry in the midst of the current fiscal situation of the Island”.

**Key Activities.** Themes identified concerning the most important activities the AAIPR must do to make the Division work included offering services in a timely manner (length of projects), communication with clients to assert their necessities (accessibility of facilities), review of relations with the industry for alliances and inter-agreements, review of compliance with regulations and accreditations, maintenance of the facilities.

In regard to offering services in a timely manner, it was emphasized by interviewee [H] that “the length of research projects should not exceed the establish completion date and if exceeded it might affect to a degree the outcome of such”.

On the other hand, related to the accessibility, interviewees [G] and [H] made similar statements regarding the use of the facilities in flexible hours. Interviewee [G] mentioned the laboratory to be used “should be adaptable for the researchers to use it to their convenience”. Similarly, interviewee [H] stated the Division and the main researcher to “have accord accessibility of the facilities for the research team at any time, for the convenience of the research and to meet due date”.

Within the relations with the industry, as to reaching potential customers, interviewee [C] mentioned the Division should “reach to companies interested in R&D, perhaps outside the Island because companies in Puerto Rico tend to be focused on services rather than R&D”. As to review of industry alliances and inter agreements, interviewee [K] who also agreed in reaching to cluster related members and made remarks on a “potential collaboration between the AAIPR and the UPRM academics”.

As to compliance with regulations, interviewee [I] mentioned as reminder for the Institute to “monitor constant compliance with aviation regulations and academic accreditation institutions”.

The maintenance of the facilities was also a mentioned activity. This pertaining to the laboratories for technical training or research projects. Interviewee [K] stated “the maintenance of hangar type laboratories is an imperative activity as such expensive and potentially risky equipment if mishandled would be dangerous unfamiliar users”.

**Key Partners.** Regarding the network of suppliers or partners (or potential) that makes the business model work, themes identified were related to resources acquired or activities performed by partners among industry players, Federal and local Government entities, and subcontracted services.

Relating to resources acquired by the aforementioned partners categories, interviewee [C] mentioned the EDA grant for the facilities, and also stated that “PRTEC having experience with grants, incentives, and as former start-up place for companies such as Infotech and Lockheed Martin would make partnering an asset for both entities”. Regarding proprietary knowledge, interviewee [A] indicated “the Division could partner with the UPRM-IP&TTO for IP consultancy”. As to human resources, ten of the twelve interviewees agreed the UPRM and UPR-Ag as the main partners to provide the researchers and research staff for the team.

As to activities, interviewee [E] stated that “in Puerto Rico, all of the AAIC should be consider a potential partner since there is no competition here (in the Island) for the Institute”. Also related to activities, interviewees [D] and [K] mentioned a partnering between the academia of the UPRM and the Division to result in beneficial for both parties. Likewise remarked by interviewee [K] was “a partnering with the CAUSE laboratory in UPRM, also created to attend emerging industry needs” (same as AAIPR creation).

Regarding subcontracted services as partners, interviewees [A], [B], [C], and [K] mentioned services such as lawyers, maintenance, security, and transportation. For example, interviewee [A] stated that “specialized lawyers can be used for developing different types of agreements as well as services for IP management”.

**Cost Structure.** Concerning the possible costs to be incurred in order to operate the business model, the subjects identified involved the physical and human resources as the most remarked by the interviewees.

Related to the physical resources, interviewees [B], [C], [H], [I], [J], and [K] concurred the biggest expense is the creations of the facilities, which is already partially funded. Also, interviewee [K] mentioned another physical resource, “the research equipment and laboratory equipment could be very expensive due to the nature of the type of industry”. Additionally, interviewee [B] and [J] mentioned “vehicles for transportation” as another physical resource expense. Interviewee [K] also mentioned equipment for the regular maintenance of the facilities and laboratories, along with the utilities.

As for human resources, expenses mentioned were all related to wages. This, for regular operational personnel, specialized personnel, internal researchers, internal research team, vehicle drivers, security, maintenance personnel. Regarding regular operational personnel, interviewees [A] and [H] concurred on example such as “office administrators, finance or accounting clerks, and legal services advisor”. For specialized personnel, interviewee [K] mentioned as essential the need for a “trained laboratory maintenance clerk for the specialized equipment and facilities”. Interviewees [G] and [H] make a remark as for “the possible biggest expense” to be the personnel related to the research, this include the main researcher and the research team. Mentioned by interviewee [B] was the “potential expense for a regular bus driver if the lot identified for the facilities results too far from the main AAIPR building”. Also, interviewee [C] made remarks on the need of security “having a private guard 24/7 especially for the Division which promises to have expensive equipment”. As for maintenance personnel, it was highlighted by interviewee [I] to have a “subcontracted company for this type of service”.

Additionally, interviewee [A] mentioned expenses related to getting protection for IP produced and the process from a research project to commercializing such IP as a “usually long and possibly expensive process if within the UPR parameters”.

Interviewee [H] made special remarks on “considering other outliers affecting the cost structure or cost of projects such as market shifts, UPR strikes, and natural disasters”.



## 4.2 Discussion of the BMCs

The BMCs were constructed using the main target segments identified by the Division management their aimed customer base. The data was integrated with the goals of the Division by applying the information gathered in the literature review in junction with the information collected from the interviews. As a summarized visual representation of the type of data used for each building block, Table 2 shows the AAIMT Integration Process. This table encompasses what was used in all of the BMCs, not individually.

The Business Model Canvas		Company: Aeronautical and Aerospace Institute for Multidisciplinary Technologies (AAIMT)		Integration Process Canvas	
<u>8. Key Partners</u> Discussion with AAIMT management Literature review Interviews with: <ul style="list-style-type: none"><li>• [A], [B], [C]</li><li>• [D], [E], [K]</li></ul> Figure 7 Figure B I	<u>7. Key Activities</u> Literature Review Interviews with: <ul style="list-style-type: none"><li>• [C], [G], [H], [I], [K]</li></ul>	<u>2. Value Proposition</u> Discussion with AAIMT management Literature review Interviews with: <ul style="list-style-type: none"><li>• All participants contributed to some degree</li></ul> Figure B2 (long term)	<u>4. Customer Relationships</u> Discussion with AAIMT management Literature Review Interview with: [A], [B], [C], [F], [G], [H], [I], [K]	<u>1. Customer Segments</u> Discussion with AAIMT management Literature review Interviews with: <ul style="list-style-type: none"><li>• All participants contributed to some degree.</li></ul>	
	<u>6. Key Resources</u> Discussion with AAIMT management Literature Review Interviews with: All except [D], [J] Figure B I		<u>3. Distribution Channels</u> Discussion with AAIMT management Literature review Interviews with: [D], [G], [H], [K]		
<u>9. Cost Structure</u> Discussion with AAIMT management. Figure B I Literature review. Interviews with:[A], [B], [C], [G], [H], [I], [J], [K]			<u>5. Revenue Streams</u> Discussion with AAIMT management. Table I Literature review. Interviews with:[A], [B], [C], [G], [H], [J], [K], [L]		

**Table 2:** AAIMT - BMC Integration Process.

Following the nine blocks of the BMC from Osterwalder & Pigneur's (2010), also used in the previous section and initially mentioned in the literature review, the BMC analyses for the AAIMT were developed with the data gathered from the literature review, meeting with the AAIPR Director, and interviews to key experts. The BMCs are identified as Canvas A, Canvas B, and Canvas C each pertaining to a customer segment. differences between the three canvases have been color marked. Items pertaining to Canvas A were marked in peach, Canvas B is marked with green, and Canvas C is marked with blue. Those items which were not marked through the BMCs remain the same for the three business models.

#### 4.2.1 Canvas A

**Customer Segment.** Identified by AAIPR management were clients such as entities, companies, or agencies either international or local interested in R&D projects.

Possible projects or subdivisions for such segment were mentioned by interviewees. It was stated by interviewee [A] that “some corporations might only need AAIMT to finish a project, or only use the facilities, and equipment, the researchers, or even all the services”. In that same category, interviewees [B], [C], [E], and [K] mentioned types of projects and companies who started or made projects in a setting similar to the AAIMT, such as the landing of Infotech in Puerto Rico. Also, highlighted in the aerospace industry section of the literature review is the beginnings of Infotech in Puerto Rico as its first location was in the PRTEC facilities.

When analyzing both remarks, it can be said that the already identified customer segment could be further subdivided as to the need of the company or entity towards the Divisions offering. Said customer segment would now have the following subdivisions;

- Entity funds project for research, AAIMT is in charge of the entire project – this would mean the AAIMT would perform the project on its entirety. In this model, if IP is created the terms of ownership, licensing, and/or royalties should be accorded in a prior agreement. This also relates to Customer Relationships for the agreement part.
- Entity funds project for research, uses AAIMT facilities and/or equipment – this means the entity will fund the project but put in charge of such a researcher and/or research team of their choosing.
- Entity project previously started, uses AAIMT facilities and/or equipment – this would mean the entity is not funding the project, only using (renting) the facilities and/or equipment. In this model it is implied that all IP produced would be owned by the renting entity.
- Entity project previously started, uses AAIMT resources – this would mean the entity has a previously started project and similarly to the previous subdivision, the entity would not be funding the project but renting the AAIMT resources. This model is comparable to the aforementioned landing of Infotech in Puerto Rico in the PRTEC

premises. This last two are the only models which considers such subdivision as a form renting.

Those four subdivisions also relate to the revenue streams because they are expected to generate IP related revenue or rent.

**Value Proposition.** Stated by management are the services to be provided and the research clusters identified. The services to be provided include R&D services for projects, IP development, and TT&C platform. The latter refers to the Division transferring (licensing, selling, leasing) or commercializing the IP developed.

Research cluster identified by the AAIMT management are Material Science Technologies, Atmospheric Sciences, Navigational and Positional Technologies, Propulsion Technologies, and Human Factors Research to sustain current and future industry development in Unmanned Aerial and Space Vehicles, also mentioned in Appendix B. Interviewees [D], [F], and [K] concurred with some of the research clusters when mentioning those of Navigational and Positional Technologies, Atmospheric Sciences, Unmanned Aerial and Space Vehicles as the proven to be emerging ones.

Other value creating bundle roughly mentioned is by author Escalona in the commercialization process at the UPR section of the literature review regarding the UPR having worldwide brand standing in STEM disciplines (2015). Similar mentions were made by interviewees regarding the STEM and engineer students.

Also, a value creating perk mentioned by interviewees, as well as in the commercialization process at the UPR and the aeronautical and aerospace industry sections of the literature review, in Appendix B and Appendix F are the compliance with aviation regulations, academic accreditations, incentives, and federal regulations.

**Distribution Channels.** Identified by management were news, social media networking, direct emails, and possible industry expos. Identified through the review of literature on Appendix B was the Select USA and Hannover Messe industry expos for which the AAIPR has participated. Mentioned by interviewee [D] was possible collaborations with outside entities being made, this

remark was referring to the recent appointment of Puerto Rico being appointed as the place for NASA Technology Infusion Road Tour of 2019 as mentioned in Appendix B.

**Customer Relations.** The management of the Division, interviewees, and data from the literature review all pointed out to the AAIMT establishment of agreements between the Division and the entity detailing type of relationship expected between the parts. Interviewees mentioned types of agreements that could be done such as work collaborative agreements or licensing agreement, which also related to the revenue stream block.

Gathered from the literature review on the BMC, the AAIC industry, data from Appendix B, and from the interviewees mentions it was inferred that the Division is expecting to do tailored services to the company/entity needs.

**Revenue Streams.** AAIMT management identified as preferable main sources of revenue royalties or licensing from IP developed. The data from the commercialization process at the UPR section in the literature review and interviewees agree for this to be the best option in an ideal business scenario. It was found that although it is the best option is not realistic, due to the UPR slow commercialization process and constricting policies. The most favorable short-term revenue option would be the fees collected for the services to be provided or special tailored assistance. Interviewees agree with literature review findings regarding the need for change towards flexibility of UPR IP and commercialization policies.

**Key Resources.** The management made emphasis in a few shared resources, such as human resources highlighting UPR students as possible interns, or research team members. See Figures B1 and B2 from Appendix B for more information regarding the forecasted human resources for AAIMT. Interviewees also mentioned the possibility and benefit of having UPR students as collaborators, as well as mentioning other human resources needed such as researchers, research team, and operational personnel.

Mentioned in the justification section of the introduction, regarding physical and financial resources, was the publication of the grant award to be used towards the construction of the AAIMT facilities made by the EDA. This award was also highlighted by interviewees as well as equipment required for R&D activities.

In the commercialization process at the UPR section from the literature review it is mentioned the UPRM IP&TTO, as well as by interviewees, partnering with such would make it a human and intellectual resource available since they could offer the IPP knowledge.

**Key Activities.** The only remark made by the management was the preferability of short research projects which was also a mention topic by interviewees.

Also mentioned by interviewees, as well as in the literature review, was the compliance with regulations and academic accreditations. This is an activity to be monitored for changes on requirements. Another activity displayed on Figure B1 in Appendix B is the maintenance of the facilities, also highlighted by interviewees.

**Key Partners.** The AAIPR has fostered partnerships from its creation propitiated by Lufthansa Technik, as mentioned in the introduction. Figure 7 from the literature review shows potential partners in Puerto Rico. The Division management has already made strives partnering with NASA and participating in industrial expos such as Select USA and Hannover Messe, these mentioned in Appendix B. Other more obvious partners worth mentioning are related federal or local government entities and private non-profit supporting entities such as the PRST-TTO mentioned in the literature review.

Additionally, mentioned by interviewees as partners were the providers of subcontracted services, see Figure B1 in Appendix B.

**Cost Structure.** To operate this business model it is needed facilities, equipment, personnel. The AAIMT management recognized some expenses which are portrayed on Figure B1 on Appendix B. Some of those expenses were also mentioned by interviewees such as subcontracted maintenance, legal advising, and transportation. Inherent costs mentioned by interviewees included outliers such as UPR system strikes, natural disaster, market shifts, and the Island current fiscal and financial crisis.

# The Business Model Canvas

Team or Company Name: **Aeronautical and Aerospace Institute for  
Multidisciplinary Technologies (AAIMT)**

☒ **Canvas A**

☐ Canvas B

☐ Canvas C

<b>8. Key Partners</b> <ul style="list-style-type: none"> <li>Government entities: <ul style="list-style-type: none"> <li>DE, PRIDCO, UPR, UPRM-IP&amp;TTO, CNDE</li> </ul> </li> <li>Federal entities: <ul style="list-style-type: none"> <li>NASA, U.S. Department of Commerce, EDA, FAA, Select USA</li> </ul> </li> <li>Other Entities: <ul style="list-style-type: none"> <li>PRST-TTO, EASA, Hannover Messe</li> </ul> </li> <li>Subcontracted services: <ul style="list-style-type: none"> <li>Legal, Transportation, Security, Media, Maintenance.</li> </ul> </li> <li>UPR-Ag provides services of: <ul style="list-style-type: none"> <li>HR, Finance, Accounting, Collections, Property, Procurement.</li> </ul> </li> <li>Figure 7: AAIC of Puerto Rico</li> </ul>	<b>7. Key Activities</b> <ul style="list-style-type: none"> <li>Maintenance of facilities, including laboratories</li> <li>Provide services offered in a timely manner (short projects)</li> <li>Constant communication with client to ascertain project/services goals</li> <li>Review of the alliances and inter-agency agreements.</li> <li>Review of compliance with regulations and academic accreditations</li> </ul> <b>6. Key Resources</b> <ul style="list-style-type: none"> <li>Physical: <ul style="list-style-type: none"> <li>Facilities creation</li> <li>Laboratory &amp; Hangar</li> <li>R&amp;D equipment</li> </ul> </li> <li>Intellectual: <ul style="list-style-type: none"> <li>Potential partner IP &amp; TTO UPRM.</li> </ul> </li> <li>Human: <ul style="list-style-type: none"> <li>Researchers and graduate students for research teams or internships</li> <li>Trained personnel for VP services.</li> </ul> </li> <li>Financial: <ul style="list-style-type: none"> <li>EDA grant for facilities.</li> <li>Financial support of the cluster for further development.</li> </ul> </li> </ul>	<b>2. Value Proposition</b> <ul style="list-style-type: none"> <li>Services of: <ul style="list-style-type: none"> <li>R&amp;D Services</li> <li>IP Development</li> <li>TT &amp; Commercialization Platform</li> </ul> </li> <li>Research clusters identified <ul style="list-style-type: none"> <li>To sustain current and future industry development</li> </ul> </li> <li>Value Adding Facts: <ul style="list-style-type: none"> <li>UPR branding with worldwide standing in STEM disciplines.</li> <li>Geographical position between three continents and surrounded by AAIC companies in Puerto Rico</li> <li>Compliance with FAA and EASA standards.</li> <li>Local and federal incentives, beneficial regulations.</li> <li>Services to be provided are considerably less than in the mainland.</li> </ul> </li> </ul>	<b>4. Customer Relationships</b> <ul style="list-style-type: none"> <li>Services will be tailored to customer needs/goals</li> <li>Work Collaborative Agreement</li> <li>Licensing Agreement if IP is produced</li> </ul> <b>3. Distribution Channels</b> <ul style="list-style-type: none"> <li>Industry Expos or Conventions: <ul style="list-style-type: none"> <li>NASA Technology Infusion Road Tour and Minority Institutions 2019</li> <li>Select USA 2016 &amp; 2017</li> <li>Hannover Messe 2016</li> </ul> </li> <li>Entity might do commercialization depending on agreement.</li> <li>Inter-agency agreements with certain companies or departments of such.</li> <li>Reach to industry and local players for collaborations</li> <li>Official website, emails, direct promo, news, social media (FB, TW)</li> </ul>	<b>I. Customer Segments</b> <ul style="list-style-type: none"> <li><b>Company, agency or entity (international or local) interested in R&amp;D projects</b> <ul style="list-style-type: none"> <li>Entity funds project for research, AAIMT is in charge of project, or</li> <li>Entity funds project for research, uses AAIMT facilities and/or equipment, or</li> <li>Entity has project previously started, uses AAIMT (renting) facilities and/or equipment, or</li> <li>Entity has project previously started, uses all AAIMT (rent) resources.</li> </ul> </li> </ul> <p>Project length from 6 months to 3 years</p>
<b>9. Cost Structure</b> <ul style="list-style-type: none"> <li>Construction of facilities, equipment for facilities, human resources to operate de facilities, specialize personnel such as researchers, research team.</li> <li>Maintenance of the programs and R&amp;D projects, patent application fees, laboratories, equipment</li> <li>Inherent costs: UPR system strikes, fiscal and financial crisis in the Island, natural disasters, market shifts</li> <li>Figure B1 of Appendix B shows the personnel needed to run the facilities.</li> </ul>		<b>5. Revenue Streams</b> <ul style="list-style-type: none"> <li>Fees charged for services provided to entity on Work Collaborative Agreement</li> <li>Developed IP of UPR ownership, terms on Table I.</li> <li>Upon agreement with customer the Institute will have forms of revenues in Asset sale; Usage fee; Lending/renting/leasing; Licensing. Example of Licensing would be a % for the use of such technology created.</li> </ul>		

#### 4.2.2 Canvas B

This BMC was constructed with the data gathered from the AAIPR management, literature review, and interviews. It shares some of the results from Canvas A. This model only considers UPR researchers who are not being directly employed by the AAIPR.

**Customer Segments.** Identified by management were UPR researchers using federal, UPR, local government, or public funding for R&D project.

Concerning the procurement of research funds by researchers, interviewees remarked on the difficulty to obtain funds and the lengthy process for such, as well as the usual length for said type of project. It was remarked that this kind of projects could last up to five years.

The subdivisions developed for Canvas A could be applied to this customer segment as follows;

- Using all resources for a project. This will include assistance for the procurement of partial or complete funds for the project.
- Using all resources for a previously started project. This will also include assistance for the procurement of partial or complete funds for the project.
- Using all resources for a fully funded project.
- Using all resources for a fully funded-previously started project.
- Using only facilities and/or equipment for a project.
- Using only facilities and/or equipment for a previously started project.

The creation of IP would not affect significantly as the ownership is of the UPR.

This building block is intricately intertwined with the rest of this business model due it containing many subdivisions options many of those related to funding.

**Value Proposition.** Due to the remarks by the interviewees on the difficulty to obtain funds and the lengthy process for such another value opportunity for the AAIMT emerged. It was added providing the assistance for the procurement of partial or complete funds for the project. The other value propositions are shared with Canvas A.

**Distribution Channels.** Remarks made by management towards this block remain the same as Canvas A.

Stated in the commercialization process at the UPR section of the literature review was the inclination of researchers to journal publications of R&D projects made. This fact was also mentioned by interviewees, adding to it, participating in conferences to present the creations will draw attention to the creation. More attention could result in more funding options and opportunities for the further development of the project.

**Customer Relations.** Remarks made by management towards this block remain the same as Canvas A with the exception of the agreements being done with researchers rather than to entities.

Interviewees mentioned research collaborative agreement as the type of accord to be made between the Division and the researcher. Also, interviewee [G] mentioned another type of agreement applicable saying that “cooperative agreements and grants being types of contracts”. That type of agreement is mentioned in the commercialization process at the UPR section of the literature review as types of federal funding awards.

**Revenue Streams.** Remarks made by management towards this block remain the same as Canvas A.

Attending remarks made about the need for change towards flexibility of UPR IP and commercialization policies. A suggestion for a simple policy change was made by interviewee [A], this included reallocating the royalties from IP produced distribution to being more beneficial towards the researcher, and more flexible when claiming entire UPR ownership.

In this model, since such projects are up to five years, the long-term approach of licensing or selling the IP produced, could be used, and would be even more beneficial if the remarks suggested were enacted. The other revenue streams are shared with Canvas A.

**Key Resources.** Remarks made by management towards this block are the same as Canvas A.

Federal funding awards, which was mention in the customer relations block by interviewee [G] as a type of agreements is also part of the financial resources block. Differences



between federal funding awards are mentioned in the commercialization process at the UPR section of the literature review as follows;

- Grant – not much involvement with who awards the funds (John Hopkins University Research Administration, 2017).
- Cooperative Agreement – funds awarded with certain restrictions including the involvement of the benefactor to some degree. The degree and type of restrictions are to be stipulated in such (John Hopkins University Research Administration, 2017).
- Federal Contract – “usually subject to a strict set of terms and conditions, including clauses that usually requires a high level of responsibility to the sponsor” (Purdue University, 2015, p. 2).

Another remark made by the interviewees, was the motivation for the customer segment to use the AAIMT, this referring to established researchers. It was concluded that providing work space facilities would not be incentive enough but providing physical resources such as especial equipment, technical laboratories, or the adjacency to the AAIC would be enough motivation. The other key resources are shared with Canvas A.

**Key Activities.** For this model, the pertinent remarks include those made by interviewees regarding the constant communication with the researchers to assert their necessities, review of compliance with regulations and accreditations, and the maintenance of the facilities. Regarding the communication with the researchers mentions such as the flexibility for accessibility of the facilities. An activity to be periodically monitored is the compliance with regulations and academic accreditations and the maintenance of facilities such as specialized laboratories.

**Key Partners.** The key partners for this model are shared with Canvas A.

**Cost Structure.** The cost structure for this model is shared with Canvas A.

# The Business Model Canvas

Team or Company Name: **Aeronautical and Aerospace Institute for Multidisciplinary Technologies (AAIMT)**

☐ Canvas A

☒ **Canvas B**

☐ Canvas C

<div>8. Key Partners</div> <ul style="list-style-type: none"><li>Government entities:<ul style="list-style-type: none"><li>DE, PRIDCO, UPR, UPRM-IP&amp;TTO, CNDE</li></ul></li><li>Federal entities:<ul style="list-style-type: none"><li>NASA, U.S. Department of Commerce, EDA, FAA, Select USA</li></ul></li><li>Other Entities:<ul style="list-style-type: none"><li>PRST-TTO, EASA, Hannover Messe</li></ul></li><li>Subcontracted services:<ul style="list-style-type: none"><li>Legal, Transportation, Security, Media, Maintenance.</li></ul></li><li>UPR-Ag provides services of:<ul style="list-style-type: none"><li>HR, Finance, Accounting, Collections, Property, Procurement.</li></ul></li><li>Figure 7: AAIC of Puerto Rico</li></ul>	<div>7. Key Activities</div> <ul style="list-style-type: none"><li>Maintenance of facilities, including laboratories</li><li>Provide services offered in a timely manner (short projects)</li><li>Constant communication with client to ascertain project/services goals - flexibility for researcher and research team for the accessibility of the facilities</li><li>Review of the alliances and inter-agency agreements.</li><li>Review of compliance with regulations and academic accreditations</li></ul> <div>6. Key Resources</div> <ul style="list-style-type: none"><li>Physical:<ul style="list-style-type: none"><li>Facilities creation</li><li>Laboratory &amp; Hangar</li><li>R&amp;D equipment</li></ul></li><li>Intellectual:<ul style="list-style-type: none"><li>Potential partner IP &amp; TTO UPRM.</li></ul></li><li>Human:<ul style="list-style-type: none"><li>Researchers and graduate students for research teams or internships</li><li>Trained personnel for VP services.</li></ul></li><li>Financial:<ul style="list-style-type: none"><li>EDA grant for facilities.</li><li>Federal funding awards (mentioned in customer relationships)</li></ul></li></ul>	<div>2. Value Proposition</div> <ul style="list-style-type: none"><li>Services of:<ul style="list-style-type: none"><li>R&amp;D Services</li><li>IP Development</li><li>TT &amp; Commercialization Platform</li></ul></li><li>Research clusters identified<ul style="list-style-type: none"><li>To sustain current and future industry development</li></ul></li><li>Assistance for procurement of partial or complete research funds</li><li>Value Adding Facts:<ul style="list-style-type: none"><li>UPR branding with worldwide standing in STEM disciplines.</li><li>Geographical position between three continents and surrounded by AAIC companies in Puerto Rico</li><li>Compliance with FAA and EASA standards.</li><li>Local and federal incentives, beneficial regulations.</li><li>Services to be provided are considerably less than in the mainland.</li></ul></li></ul>	<div>4. Customer Relationships</div> <ul style="list-style-type: none"><li>Services will be tailored to customer needs/goals</li><li>Research Collaborative Agreement</li><li>Licensing Agreement if IP is produced</li><li>Federal funding awards- type of accord to receive funding<ul style="list-style-type: none"><li>Grants – no involvement of sponsor</li><li>Cooperative agreements – some restrictions from sponsor</li><li>Federal contracts – strict terms of conditions and clauses requiring many responsibilities towards the sponsor.</li></ul></li></ul> <div>3. Distribution Channels</div> <ul style="list-style-type: none"><li>Journal publications, academic and industry conferences</li><li>Industry Expos or Conventions:<ul style="list-style-type: none"><li>NASA Technology Infusion Road Tour and Minority Institutions 2019</li><li>Select USA 2016 &amp; 2017</li><li>Hannover Messe 2016</li></ul></li><li>University agreements with certain departments.</li><li>Reach to industry and local players for collaborations</li><li>Official website, emails, direct promo, news, social media (FB, TW)</li></ul>	<div>1. Customer Segments</div> <ul style="list-style-type: none"><li>UPR system researchers using federal, UPR, local government, or public funding for R&amp;D project</li><li>Using all the resources for the research project which could include assistance for the procurement of partial or complete research funds, or</li><li>Using all the resources for a previously started project which could include assistance for the procurement of partial or complete research funds, or</li><li>Using all resources for a fully funded project, or</li><li>Using all resources for a fully funded previously started project, or</li><li>Using only the facilities and/or equipment for a research project, or</li><li>Using only the facilities and/or equipment for a previously started project.</li></ul> <div>Length of project from 1 to 5 years</div>															
<div>9. Cost Structure</div> <ul style="list-style-type: none"><li>Construction of facilities, equipment for facilities, human resources to operate de facilities, specialize personnel such as researchers, research team.</li><li>Maintenance of the programs and R&amp;D projects, patent application fees, laboratories, equipment</li><li>Inherent costs: UPR system strikes, fiscal and financial crisis in the Island, natural disasters, market shifts</li><li>Figure B1 of Appendix B shows the personnel needed to run the facilities.</li></ul>	<div>Revenue Streams</div> <ul style="list-style-type: none"><li>Fees on services provided settled in Research Collaborative Agreement</li><li>Upon agreement with customer the Institute will have forms of revenues in Asset sale; Usage fee; Lending/renting/leasing; Licensing.</li><li>Patent net income distribution on Table I shows royalties distribution. Recommended adjustment to the distribution and ownership are displayed here.</li></ul>			<div>Patents Net Income Distribution UPR IP Ownership not 100%</div> <table><tr><th></th><th>Current</th><th>Proposed</th></tr><tr><td>Inventors</td><td>33.33%</td><td>33%</td></tr><tr><td>Central UPR</td><td>10.00%</td><td>5%</td></tr><tr><td>UPR-Ag</td><td>10.00%</td><td>5%</td></tr><tr><td>AAIPR</td><td>46.67%</td><td>57%</td></tr></table>		Current	Proposed	Inventors	33.33%	33%	Central UPR	10.00%	5%	UPR-Ag	10.00%	5%	AAIPR	46.67%	57%
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### 4.2.3 Canvas C

This BMC was constructed with the data gathered from the AAIPR management, literature review, and interviews. It shares the majority of the results with Canvas B, and some results with Canvas A. This model only considers UPR researchers who are not being directly employed by the AAIPR. agreed

**Customer Segments.** Identified by the management were UPR system researchers with any type of funding support. Having any kind of funding support would mean that if a company/entity funded partially or completely a researcher for a project the model would become a combination of both Canvas A and Canvas B.

When considering the model to be partially or completely funded from a company, subdivisions developed for Canvas A and adapted to Canvas B could be applied to this customer segment as follows;

- Using all resources for a project. This will include assistance for the procurement of partial funds for the project.
- Using all resources for a previously started project. This will also include assistance for the procurement of partial funds for the project.
- Using all resources for a fully funded project.
- Using all resources for a fully funded-previously started project.
- Using only facilities and/or equipment for a project.
- Using only facilities and/or equipment for a previously started project.

The IP created in such model will have terms of ownership, licensing, and/or royalties that should be accorded between all parts in an agreement made prior to the starting the project. In this model, the remaining building blocks will be a merge containing both Canvas A and Canvas B.

A model in where the researcher is to be funded by any other kind of means, which does not include awards containing terms of use that could compromise the Division or the customer segment, will follow the remaining building blocks as Canvas B.

# The Business Model Canvas

Team or Company Name:

Aeronautical and Aerospace Institute for  
Multidisciplinary Technologies (AAIMT)

☐ Canvas A

☐ Canvas B

☒ Canvas C

<h3>8. Key Partners</h3> <ul style="list-style-type: none"> <li>Government entities: <ul style="list-style-type: none"> <li>DE, PRIDCO, UPR, UPRM-IP&amp;TTO, CNDE</li> </ul> </li> <li>Federal entities: <ul style="list-style-type: none"> <li>NASA, U.S. Department of Commerce, EDA, FAA, Select USA</li> </ul> </li> <li>Other Entities: <ul style="list-style-type: none"> <li>PRST-TTO, EASA, Hannover Messe</li> </ul> </li> <li>Subcontracted services: <ul style="list-style-type: none"> <li>Legal, Transportation, Security, Media, Maintenance.</li> </ul> </li> <li>UPR-Ag provides services of: <ul style="list-style-type: none"> <li>HR, Finance, Accounting, Collections, Property, Procurement.</li> </ul> </li> <li>Figure 7: AAIC Map of Puerto Rico</li> </ul>	<h3>7. Key Activities</h3> <ul style="list-style-type: none"> <li>Maintenance of facilities, including laboratories</li> <li>Provide services offered in a timely manner (short projects)</li> <li>Constant communication with client to ascertain project/services goals - flexibility for researcher and research team for the accessibility of the facilities</li> <li>Review of the alliances and inter-agency agreements.</li> <li>Review of compliance with regulations and academic accreditations</li> </ul> <h3>6. 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Value Proposition</h3> <ul style="list-style-type: none"> <li>Services of: <ul style="list-style-type: none"> <li>R&amp;D Services</li> <li>IP Development</li> <li>TT &amp; Commercialization Platform</li> </ul> </li> <li>Research clusters identified <ul style="list-style-type: none"> <li>To sustain current and future industry development</li> </ul> </li> <li>Assistance for procurement of partial or complete research funds</li> <li>Value Adding Facts: <ul style="list-style-type: none"> <li>UPR branding with worldwide standing in STEM disciplines.</li> <li>Geographical position between three continents and surrounded by AAIC companies in Puerto Rico</li> <li>Compliance with FAA and EASA standards.</li> <li>Local and federal incentives, beneficial regulations.</li> <li>Services to be provided are considerably less than in the mainland.</li> </ul> </li> </ul>	<h3>4. 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Includes procurement for partial funds for the project, or</li> </ul> </li> <li>Using all resources for a previously started project which could also include assistance for the procurement of partial funds for the project, or</li> <li>Using all resources for a fully funded project in which the division serves as incubator, or</li> <li>Using all resources for a fully funded previously started project in which division serves as incubator,</li> <li>Using only the facilities and/or equipment for a project, or</li> <li>Using only the facilities and/or equipment for a previously started project.</li> </ul> <p><b>With research funds not containing terms which could compromise the Division or the researcher (this option would follow the remaining building blocks as Canvas B).</b></p> <p>Project length from 6 months to 5 years</p>																
<h3>9. Cost Structure</h3> <ul style="list-style-type: none"> <li>Construction of facilities, equipment for facilities, human resources to operate de facilities, specialize personnel such as researchers, research team.</li> <li>Maintenance of the programs and R&amp;D projects, patent application fees, laboratories, equipment</li> <li>Inherent costs: UPR system strikes, fiscal and financial crisis in the Island, natural disasters, market shifts</li> <li>Figure B1 of Appendix B shows the personnel needed to run the facilities.</li> </ul>	<h3>Revenue Streams</h3> <ul style="list-style-type: none"> <li>Fees on services provided settled in Work Collaborative Agreement or Research Collaborative Agreement</li> <li>Upon agreement with customer the Institute will have forms of revenues in Asset sale; Usage fee; Lending/renting/leasing; Licensing.</li> <li>Patent net income distribution on Table I shows royalties distribution. Recommended adjustment to the distribution and ownership are displayed here.</li> </ul>	<table border="1"> <thead> <tr> <th colspan="3">Patents Net Income Distribution UPR IP Ownership not 100%</th> </tr> <tr> <th></th> <th>Current</th> <th>Proposed</th> </tr> </thead> <tbody> <tr> <td>Inventors</td> <td>33.33%</td> <td>33%</td> </tr> <tr> <td>Central UPR</td> <td>10.00%</td> <td>5%</td> </tr> <tr> <td>UPR-Ag</td> <td>10.00%</td> <td>5%</td> </tr> <tr> <td>AAIPR</td> <td>46.67%</td> <td>57%</td> </tr> </tbody> </table>	Patents Net Income Distribution UPR IP Ownership not 100%				Current	Proposed	Inventors	33.33%	33%	Central UPR	10.00%	5%	UPR-Ag	10.00%	5%	AAIPR	46.67%	57%
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#### **4.2.4 Canvases Remarks**

The differences between the three canvases have been color marked. Items pertaining to Canvas A were marked in peach, Canvas B is marked with green, and Canvas C is marked with blue. Those items which are not marked through the BMCs remain the same for the three business models.

For the customer segments identified, AAIPR management favored the one used for Canvas A. Here, the management of the Division anticipated that commercializable technology produced would be best if managed by the sponsor and the AAIMT receiving certain royalties or licensing proceeds. Pursuing the possibility of not having to share with a sponsor the ownership or proceeds of commercializable technology resulting by projects of UPR researchers the Canvas B and Canvas C were developed.

Canvas C is the least profitable having the highest risk of sharing the proceeds to multiple parties especially if the project was funded by both an entity and a type of federal funding award. Canvas A is the following least profitable per project also due to the high possibility of sharing proceeds; has the shortest length of projects which can result in more projects, subsequently compensating for the less profitability.

Neither of the Canvases explored avoid the possibility of not having the share with a sponsor the ownership or proceeds of commercializable technology. For Canvas B and C, in the best of scenarios, there is still risk through the UPR Central Administration ownership and when the researcher has been granted a type of federal funding awards for Canvas B and Canvas C.

Canvas B is potentially the option for most profitability per project as well as stake in IP produced. This if the rights to the ownership or proceeds of commercializable technology are granted or flexible towards the AAIPR and a grant is the type of federal fund award.

Related to the terms of ownership, licensing, or royalties when IP is created, this research reassured that any creation or agreement with an outside entity regarding such has to be approved by the UPR Central Administration. This could cause delays in the business model.

Additionally, gathered from the analysis of the three canvasses, was the following;

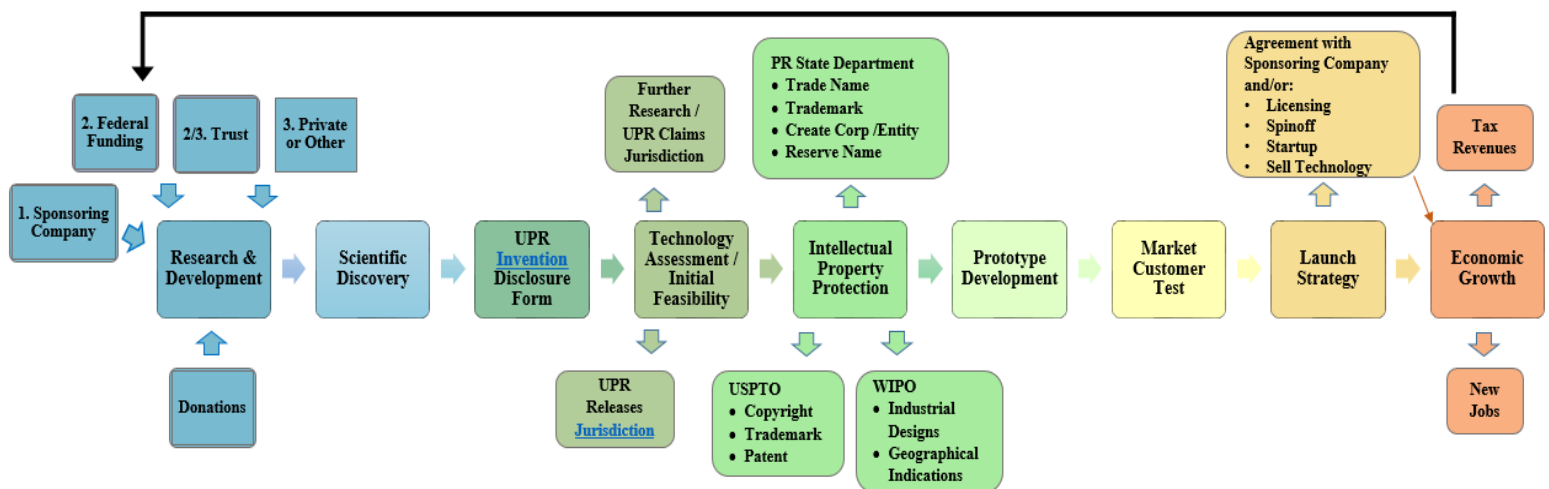
- Management prefers short-term project funded from companies, with potential for IP licensing and royalties or selling IP. This option is not viable due to remarked lack of efficiency from UPR IP commercialization process, and constricting UPR policies.
- Available is short-term project from Canvas A having to accord with the customer segment the terms if IP is produced. Or a short-term project from Canvas C having a similar setting as the one for Canvas A with the exception of the possibility of having IP produced not be subjected by another entity.
- The best option towards having more stake in the IP produced would be Canvas B, a longer project.
- It is recommended to management to use the Canvas A for the first operating years of the Division, this because a shorter project would make it more beneficial for the AAIMT as this way they could be managing more projects. The second option recommended is Canvas B.
- The development of Canvas C was not necessary because between the information gathered with Canvas A and Canvas B it is covered the same information having different customer segments.
- Even though the services of TT&C platform remarked as the most profitable, its use is not advisable with their current legal structure. For this service to be successful, it is recommended a change in UPR policies, such as the one mentioned in Canvas B and Canvas C or towards UPR corporate subsidiary entities like the AAIPR. If some of those changes are made, this service would be the recommended to be their long-term goal.

### **4.3 Additional Contributions.**

In addition to the development of the BMCs there were additional contributions found in the process of analyzing the literature review, interviews and integrating the data gathered. These were organized as a means of supporting findings.

**Flowchart.** From the data gathered in the commercialization process at the UPR section in the literature reviewed, the information provided by the interviewees, and the Director of the Institute, a commercialization path flowchart for the AAIMT was created.

The flowchart in Figure 9 shows the complete steps a research project initiative of the AAIMT could follow; it does not consider a specific target segment nor sub-segment. This flowchart can help assess the distribution channel blocks when a project is completed. It compliments those presented in the commercialization process of the UPR section of the literature review.



**Figure 9:** Commercialization Path Flowchart for the AAIMT

**Binder.** A binder was created for the management of the AAIMT division which contains a compilation of UPR relevant policies, pertinent regulations, forms, as well as possible incentives. This compilation was categorized into applicable themes. Information from this binder helped assess the UPR policies regarding the ownership of IP produced. The table of content used for this binder is presented in Appendix F.

**SWOT.** The SWOT matrix analysis for the AAIMT was created to assess the internal and external factors of the division for possible strategies. As a strategic planning tool, the matrix helped to determine the current situation of the Division compared to their goals. This, to assert the needs to meet the Division goals and complement the BMC for accuracy. The data used to create the SWOT was from the introduction, aeronautical and aerospace industry section of the

literature review, and from Appendix B. These were gathered from the AAIPR/AAIMT perspective for maintaining accuracy as regard to mission, vision, and goals of the Division. To create the strategies input from the interviewees and additional literature review was also used.

<div> <div>External Factors (EFAS)</div> <div>Internal Factors (IFAS)</div> </div>	<b>Strengths (S)</b> <ul style="list-style-type: none"> <li>• AAIPR facilities</li> <li>• Services: R&amp;D, IP, and TT&amp;C</li> <li>• UPR researchers and branding</li> <li>• Location</li> <li>• UPR-Ag Administrative support</li> <li>• Compliance with federal regulations due to status and US citizenship</li> </ul>	<b>Weaknesses (W)</b> <ul style="list-style-type: none"> <li>• Facilities for the Division partially funded, not yet created/available</li> <li>• Slow UPR bureaucratic processes</li> <li>• Services not yet being offered</li> <li>• Constricting IP commercialization policies by the UPR</li> </ul>
	<b>SO Strategies</b> <p>Use the services offering to attract customer within the AAIC alliances and among non-UPR researchers</p> <p>Use the customers attracted applying for incentives and funding options</p>	<b>WO Strategies</b> <ul style="list-style-type: none"> <li>• Use incentives to attract potential funding for completion of facilities</li> <li>• Grant proposals for project funding can be developed prior to completion of facilities</li> <li>• Use alliances with AAIC as a means of commercializing IP generated</li> </ul>
<b>Threats (T)</b> <ul style="list-style-type: none"> <li>• Funding for projects not guaranteed</li> <li>• Financial and fiscal crisis in the Island</li> <li>• Less expensive in farther countries</li> <li>• Market shift</li> <li>• Natural disasters</li> <li>• UPR system strikes</li> </ul>	<b>ST Strategies</b> <p>Highlight the services to be provided, compliance with federal regulations, and location as a superior element than an inexpensive farther country when attracting customers</p>	<b>WT Strategies</b> <ul style="list-style-type: none"> <li>• Grant proposals for project funding can be developed prior to completion of facilities.</li> <li>• Predict market shift, take advantage customizing services to be offered.</li> <li>• Provide alternative education services towards reducing the possibility of a UPR strike.</li> </ul>

**Figure 10:** SWOT Matrix Analysis for the AAIMT Division. Layout for the matrix is from (Wheelen & Hunger, 2012, p. 187). Content is Copyright © Edmée M. Cortés Valle, 2018.



## **5. CONCLUSION AND RECOMMENDATIONS**

### **5.1 Conclusion**

This project develops an alternative business model for the AAIMT using the BMC. Three business models were created for target segments identified by the AAIMT. The target segments identified were; 1) Entity, agency, or company local or international interested in R&D projects; 2) UPR researchers using federal, local government, UPR, or public funding for R&D project and; 3) UPR researchers with any type of funding for R&D project.

To develop the BMCs, the themes researched included the AAIPR and AAIMT, the commercialization process at the UPR, the AAIC, and the BMC tool. The target segments identified were categorized as Canvas A, Canvas B, and Canvas C. The main proposed services offered by the AAIMT are R&D services or work space, IP development, and a TT&C platform for identified AAIC research clusters which would contribute to the growth of the AAIC in Puerto Rico.

The BMCs were developed with the applying the themes researched, important remarks which arose from the results were:

Canvas C was found to be the least profitable, having the largest risk of low-to-no stake in IP produced being this divided among the sponsoring parties.

Neither of the Canvases developed avoided the possibility of not having to share with a sponsor the ownership or proceeds of commercializable technology.

The option determined ideally as the best BMC was Canvas B, this due to it being the option towards having more stake in the IP produced, as well as the IP and TT&C services being remarked as the most profitable.

As a result of this research process it was determined that the development of Canvas C was not necessary. This because information portrayed in Canvas C was already contained in Canvas A and Canvas B. Although significant changes might be found when choosing to compare subdivisions within a Canvas or among Canvases.

## **5.2 Recommendations**

It is recommended to management to use the Canvas A for the first operating years of the Division, this because a shorter project would make it more beneficial for the AAIMT as this way they could be managing more projects.

Even though Canvas B is potentially the most profitable option is not currently recommended for the AAIMT as it entails longer projects which could be delayed even more due to current UPR commercialization and IP ownership policies. For Canvas B to be successfully used, it is recommended a change in UPR policies, such as the one mentioned in Canvas B and Canvas C. If some of those changes are made, this service would be the recommended to be their long-term goal.

It is also recommended to the AAIMT, to reassess their goals and objectives once the facilities are constructed and later when their other projected initiatives are completed. Another BMC analysis can be performed internally after the facilities are operating and another when each of those objectives are met. This will allow management to visually compare the division at each stage as well as help management assess the proper focus towards the Division goals of financial sustainability and growth.

## **5.3 Project Limitations**

Some of the limitations of the project were regarding the facilities of the Division not yet created. The project was executed with the goals of the AAIMT and their identified target segments; it does not consider changes the Division management could have after the project began developing. The BMC was the only tool used as strategic management for developing the alternative business models; SWOT matrix was used as an additional contribution tool to help assess the Division. An existent research project case from the Division could not be used for comparison when developing the BMCs; the reference examples were from the AACST. The effectiveness of the alternative business models created was not measure because it could not be implemented.

Topics such as the cost structure and revenue streams were not properly assessed due to the lack of financial information gathered. There was difficulty accessing financial data even for

possible benchmarks of other UPR corporate subsidiaries or similar Puerto Rico based entities in other industries.

#### **5.4 Future Projects**

It is recommended the use of quantitative analyses for the accuracy of future projects. This could include gathering financial information when the Division starts operating, compare such information within internal projects. A qualitative analysis with quantitative elements could be the interviews portion of the study as a questionnaire instead of open questions. It is also suggested that the interview portion be tailored to each interviewee and the specialty of the field being studied.

Another opportunity for future projects could be to focus on a narrower customer segment base such as the subsections developed. Also, the BMC could be modified to attend sections such as cost structure and revenue stream which is core when developing a financially sustainable business. These building blocks could be expanded in the canvas, taking the place of another building block.

This project represents an initial analysis to explore the means for implementing the BMC as an alternative business model for a UPR corporate subsidiary research facility in a growing industry such as the AAIC. The BMC provided for the Division can help assess the current status and help predict viable options. Once the Division is operating the Canvas can be implemented and/or changed to meet possible changes on the management goals. The Institute needs to become financially self-sustainable and grow, the use of this can help management decide among various options without having to incur in expenses such as business plan.

Some of the analyses made throughout the project were excessive for the use of the BMC as a tool but essential for the accuracy of the entity being evaluated. Those analyses were made with the purpose of creating the BMC as precise as possible for the scope of the project. The instruments used to obtain the outcomes for this project can be used separately although if used for a similar study it is recommended the use of each part. It is also encouraged to expand its scope.

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## APPENDIX A

### UPR Corporate Subsidiaries.

UPR Corporate Subsidiaries	Date of Incorporation	Certificate of Incorporation Description
<b>Material Characterization Center, Inc.</b>	April 14, 1999	Purpose of providing technical consultancy and analysis services to all kind of industries, the government and other academic institutions.
Molecular Science Building, Inc.	Mar. 23, 2011	Principal objective is the administration and operation of the Molecular Science Building of the UPR. As well as, promote and develop whichever other legal businesses under the laws of the Commonwealth and under the General Law of Corporations of Puerto Rico.
<b>Molecular Sciences Research Center</b>	Mar. 27, 2017	
<b>Aeronautical and Aerospace Institute of Puerto Rico, Inc.</b>	April 30, 2014	To promote the growth of the aviation, aeronautical and aerospace industries, including operations dedicated to the maintenance, repair and overhaul ("MRO") of aircrafts (collectively, the "Industry").
<b>Viride Innovation Technologies, Inc.</b>	Feb. 23, 2016	Purpose of administering the rights in the inventions and technologies of the UPR related to the technological apparatus or devices and systems for the solution of energy efficiency problems and renewable energy that will allow the creation of employment for students.
	Dec. 23, 2016	<b>Purpose of doing R&amp;D activities, management of inventions and technologies related to technological apparatus or devices and systems for the solution of common problems in the residential, commercial or industrial sector and servicing the University through job creation.</b>

**UPR Research Facilities.** As of January 2016, these were the total of the UPR research facilities under each campus.

UPR R&D Facilities (as of January 2016)	Assigned Campus	Quantity
<b>Research Centers and Facilities</b>	Rio Piedras Campus	17
	Mayagüez Campus	30
<b>Research Training Centers</b>	Central UPR	7
	Medical Sciences Campus	25
	Cayey Campus	2
	Humacao Campus	7
<b>Vice Presidency for Research and Technology</b>	Resource Center for Science and Engineering	6
	Institute of Disability and Rehabilitation Research	2
<b>Total UPR R&amp;D Research Facilities</b>		<b><u>96</u></b>

## APPENDIX B

**AAIPR, Inc. Supporting Information.** The AAIMT Division will be located in adjacent premises to the AAIPR main building. Four nearby land lots have been identified in which two lots, of 29,000 square foot between both, will be used for this phase (Arroyo, 2016b). These premises account for the fourth and most important phase of the Institute which is set to bring economic growth to the cluster, therefore the Island. The development and sustainability of the AAIMT Division is crucial for the overall growth of the Institute in the near future. It is at tone with UPR and Puerto Rico strategy plans for the development and intertwining of the entities.

To generate global exposure and explore interest, the AAIPR presented the AAIMT Division as a research project in the world's biggest industrial fair, Hannover Messe, in Germany, from April 25-29 (Hannover Messe Worldwide, 2016). It presents the Institute with the opportunity of obtaining potential partners and/or investors interested in one of their five targeted research areas. As stated by Arroyo in the Hannover Messe project description (2016), these include "Materials Science Technologies, Atmospheric Sciences, Navigational and Positional Technologies, Propulsion Technologies and Human Factors Research" (par. 1).

As the current and future academic & training programs, as well as the training service center, will at some point be exploited/depleted, the importance of the AAIMT Division can be appreciated. What the AAIMT Division proposes to do in the long run is to commercialize the technology and projects they create via IP protection which is set to propitiate the creation of new patentee products that cluster related companies will manufacture and sell encouraging new businesses, new jobs and taxes as benefit to the overall Island economy. The current offerings of the AAIPR will reach a constant revenue and it is up to the AAIMT Division to compliment and continue with the Institute goals.

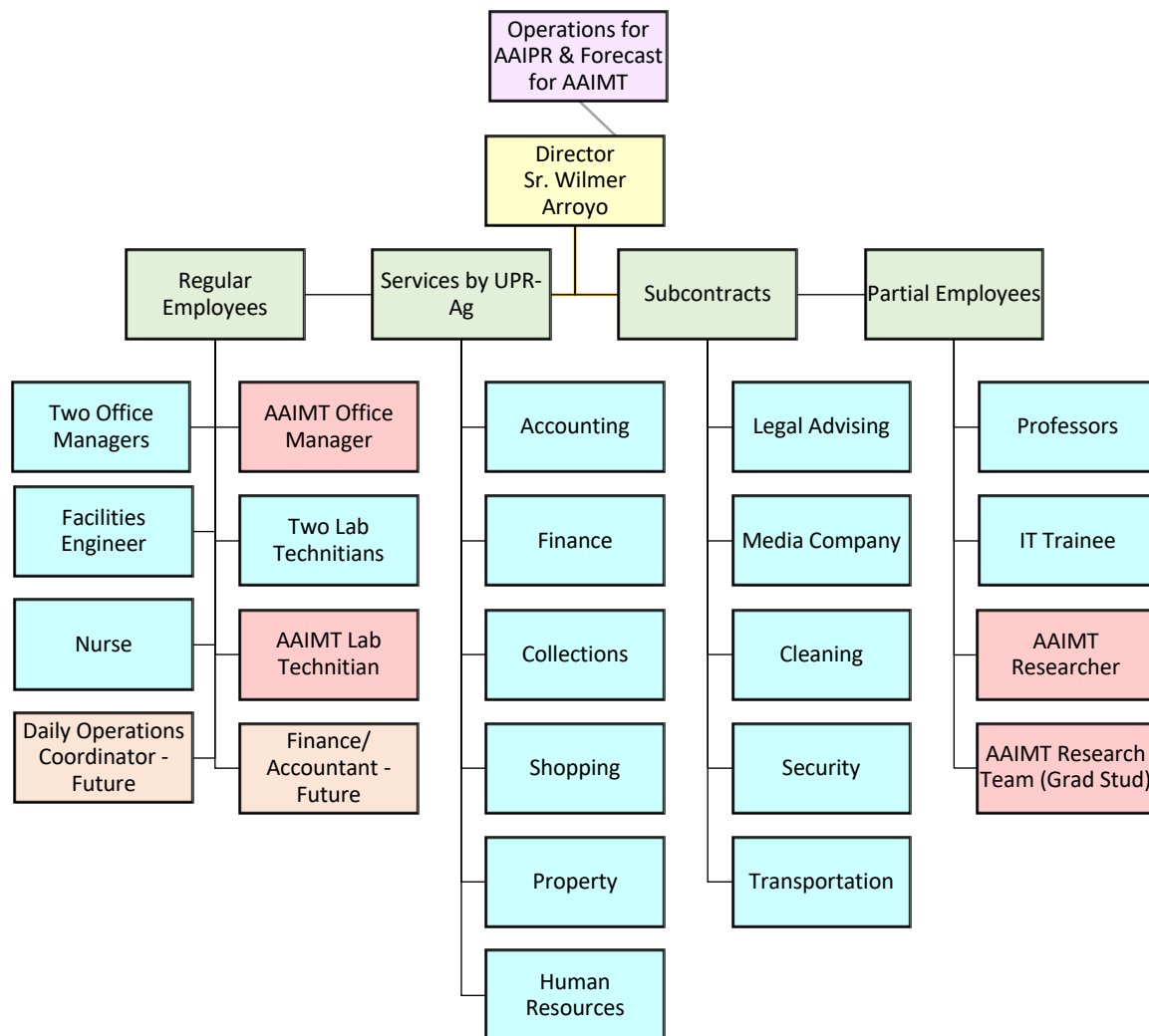
The AAIPR was created by the UPR Government Board and then incorporated in the Department of State was created through the Certification 94 from 2013-2014 (University of Puerto Rico, 2014). Even though it operates as a separate entity, the AAIPR is in alignment with Central UPR and UPR-Ag Strategic Plans, this, due to the fact the AAIPR is a subsidiary of the UPR-Ag.

For the development of this Institute there were many entities involved such as the Commonwealth of Puerto Rico and subsequently many government agencies, the UPR-Ag and Lufthansa Technik of PR. This last is a private global company with a subsidiary located in PR which has propitiated the creation of this Institute having common interests at goal. As of December 2015, Lufthansa Technik requires at least 320 skilled technicians for the first two years and projected continuous supply of 40 trained technicians per year (Arroyo, 2015b). Due to an expansion in their facilities in Puerto Rico and internationally the demand for future trainees is expected to increase, the AAIPR will attend their training as well as future needs of the AAIC in the Island and overseas.

The facilities the main building has approximately 37,500 square foot, it includes a two-story structure, divided in four sections, which contains an electronic library, class rooms, business center, and three computer labs (Autoridad para el Financiamiento de la Infraestructura, 2015). The adjacent building is a rehabilitated hangar with enough space to give practical laboratory type of classes and accommodate various aircrafts including an airbus 320-330 and a helicopter (Arroyo, 2015b). In the first level of the hangar besides the aircrafts there is an area for the instruction of hydraulic systems and turbines, as well as a separate room which will be the soldering lab. At the upper level of the hangar there are three labs; the first one is a carbon fuselage mounting which is used as the walls from inside and outside of aircrafts; the other two labs are for Avionics in electrical field and communications and radars (Arroyo, 2016b).

Shown in Figure B1 on the following page is an operations diagram of the AAIPR (Arroyo, 2016b). The UPR-Ag services is the only area which is not which is not part of the AAIPR expenses, this is part of the initial agreements upon the creation of the Institute. It also illustrates future short-term positions to fill and the initial personnel of the AAIMT. Not mentioned in the diagram are two interns under the office managers' supervision (Arroyo, 2016b). This operations diagram accounts for the current as well as some of the future human resources expenses for Institute and Division.

The AAIPR will cover needs of the AAIC with academic training programs along with research and development from the AAIMT facility. The academic offerings of the AAIPR includes:



**Figure B1:** AAIPR, Inc. Organization Diagram of Administrative Composition. Created from information gathered from (Arroyo, 2016). Copyright © Edmée M. Cortés Valle, 2018

- a. A six month accelerated entry level mechanical aviation offering focusing Base Aircraft Overhaul Program MRO (Cat-A) based on EASA Category A curriculum. This program uses the Structures laboratory and focuses on maintenance, repair and overhaul, MRO,

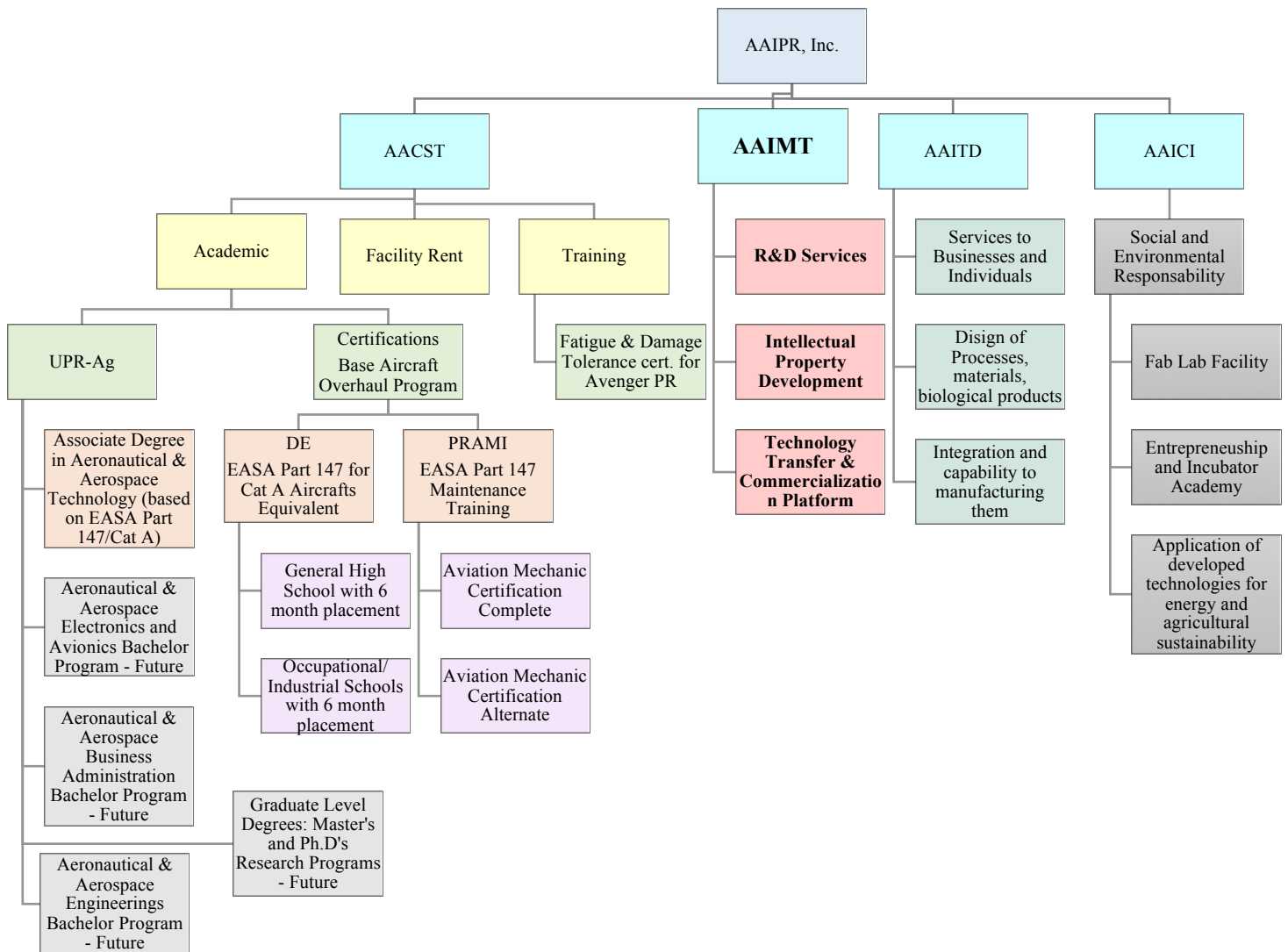
and overall knowledge in Airbus 320-330 and, it will qualify those who take it for the position of Aviation Mechanic Assistant in LTPR.

- b. Following the guidelines from the *Federal Aviation Administration* (FAA), is the Certification Part 147 – Aviation Maintenance Technician, the FAA Certified the Puerto Rico Department of Education, for this curriculum which is also supported by the Structure specialized laboratory.
- c. They also offer a two-year Associate Degree in Aeronautical & Aerospace Technology approved by the Education Council of Puerto Rico and follows ABET accreditation standards (Arroyo, 2015a).
- d. An Aerospace Electronics Bachelor's Degree Program with support classes from the UPR-Ag is the next program schedule.
- e. Pending curriculum approval is an Aeronautical & Aerospace Business Administration Program schedule to begin in January 2017.
- f. Aeronautical & Aerospace Engineering Bachelor Program set to begin in January 2017.
- g. In alliance with Avenger PR, as part of the AACST Division, the Institute offered for spring 2016 a 32-hour course for graduates or soon-to-be graduates engineers in Fatigue & Damage Tolerance. This course is in compliance with the Aging Aircraft Safety Rule and includes the new Part 26 requirement.
- h. Mitron Technologies Puerto Rico rented the AAIPR facilities to end operations and close the company on the Island from December 2015-January 2016.

As of December 2015, the first group of 23 students from Lufthansa were awarded as Certified Aircraft Technicians (Cat-A) for the Base Aircraft Overhaul Program. Those 23 students then were interviewed by Lufthansa and passed to the second phase of their training which took place in Europe for an amount of six more months (University of Puerto Rico, 2015). The second group of students for this program began on November 2015 and the third in July 2016. The cost of this entire program is \$6,700 for the six months.

The Associate Degree has, as of its first year of operations, a total of 100 students and it is expected 130 more students for August 2016. The cost of this entire program is \$9,000 for the two years and if the student qualifies it could be entirely subsidized by the Pell Federal Scholarship. A diagram of the AAIPR composition is shown in Figure B2 presented in the next

page. Besides the AACST and the AAIMIT, the other two initiatives of the AAIPR presented in Figure B2 are the Aeronautical and Aerospace Institute for Technology Design (AAITD) for digital manufacturing in engineering, and the Aeronautical and Aerospace Institute of Creative Integration (AAICI) for implementing a “social and environmental responsible component” (Arroyo, 2016a, p.27).



**Figure B2:** AAIPR, Inc. Divisions Offerings Diagram. Constructed from information gathered from (Arroyo, 2016, 2017). Copyright © Edmée M. Cortés Valle, 2018.

AAIPR offers the “first learning program specialized in MRO registered in the U.S.”, this apprenticeship program is design to have an international approach (Caribbean Business, 2017).

Recent remarks include the construction of a wind tunnel, FLOTEK 1440, to analyze superficies curvatures, fluid behavior, and the study of material adaptable to aircraft aerodynamics (NotiCel, 2018).

The participation of the AAIPR director, Sr. Wilmer Arroyo as a member of the University Briefing Sessions panel of NASA’s Technology Infusion Road Tour and Minority Institutions highlighted the capabilities and added value of the UPR in international relations (Inter News Services, 2018) . This, was celebrated in Clark Atlanta University, Georgia on March 28 and 29 of the year 2018 (Taliwaku Kalisa, 2018, p. 13). Here, it was announced that on May 21 and 22 of 2019 this event will be held at the AAIPR. (La Isla Oeste in Últimas, 2018).



## APPENDIX C

BMC Nine Building Blocks Defined (Osterwalder & Pigneur, Business Model Generation, 2010):

- a. Customer Segments – Groups of people the organization aims to reach and serve (p. 20). Some examples could be mass market, niche market, segmented, and multi-sided platforms or markets (p.21).
- b. Value Proposition – Products and/or services that create value for the specific Customer Segment (p. 22). Newness, performance, customization, “getting the job done”, design, brand/status, price, cost reduction, risk reduction, accessibility, convenience/usability (p.23-25).
- c. Distribution Channels – Communication of the organization to reach the Customer Segment to deliver the Value Proposition (p. 26). Own Direct – Sales force, web sales; Own Indirect – Own stores; Partner Indirect – Partner stores, Wholesaler (p.27).
- d. Customer Relationships – Organizations relationship with the Customer Segment (p. 28). Personal assistance, dedicated personal assistance, self-service, automated services, communities, co-creation (p.29).
- e. Revenue Streams – Cash the organization generates from each Customer segment after the costs have been subtracted (p. 30). Asset sale, usage fee, subscription fees, lending/renting/leasing, licensing, brokerage fees, advertising (p. 31-33).
- f. Key Resources – Most important assets required to make the business model work (p. 34). Physical, intellectual, human, financial (p.35).
- g. Key Activities – Most important thing the organization must do to make its business model work (p. 36). Production, problem solving, platform/network (p.37).
- h. Key Partners – Network of suppliers and partners that make the business model work (p. 38). Optimization and economy of scale, reduction of risk and uncertainty, acquisition of particular resources and activities (p.39).
- i. Cost Structure – All costs incurred to operate the business (p. 40). Cost driven or value driven (p.40).

# The Business Model Canvas

Team or Company Name:

Date:

/ /

- ☐ Primary Canvas  
☐ Alternative Canvas

<p><b>8. Key Partners</b>          Who are our Key Partners?           Who are our Key Suppliers?           Which Key Resources are we acquiring from partners?           Which Key Activities do partners perform?</p> <p><b>Describes the network of suppliers and partners that make the business model to work.</b></p> <ul style="list-style-type: none"> <li>• <b>Optimization and economy of scale</b> – partnerships such as buyer-supplier for optimization for the allocation of resources and activities.</li> <li>• <b>Reduction of risk and uncertainty</b> – Strategic alliances.</li> <li>• <b>Acquisition of particular resources and activities</b> – extension of the company's own capabilities by relying on other firms to furnish particular resources or perform certain activities.</li> </ul>	<p><b>7. Key Activities</b>          What Key Activities do our Value Propositions, Distribution Channels, Customer Relationships, and/or Revenue streams require?</p> <p><b>Describes the most important things a company must do to make its business model to work.</b></p> <ul style="list-style-type: none"> <li>• <b>Production</b> – designing, making, delivering a product.</li> <li>• <b>Problem solving</b> – coming up with new solutions for customer products. It can include continuous training knowledge management.</li> <li>• <b>Platform/network</b> – networks, matchmaking platforms, software or brands.</li> </ul> <p><b>6. Key Resources</b>          What Key Resources do our Value Propositions, Distribution Channels, Customer Relationships, and/or Revenue Streams require?</p> <p><b>Describes the most important assets required to make a business model to work.</b></p> <ul style="list-style-type: none"> <li>• <b>Physical</b> – facilities, buildings, vehicles, distribution networks.</li> <li>• <b>Intellectual</b> – brands, proprietary knowledge, patents, copyrights, partnerships, consumer databases.</li> <li>• <b>Human</b> – prominent in knowledge-intensive and creative industries.</li> <li>• <b>Financial</b> – financial guarantees such as cash lines of credit, or stock options.</li> </ul>	<p><b>2. Value Proposition</b>          What value do we deliver to the customer?</p> <p>Which one of our customer's problems are we helping to solve?</p> <p>What bundles of products and services are we offering to each Customer Segment?</p> <p>Which customer needs are we satisfying?</p> <p><b>Describes the bundle of products and services that create value for a specific customer segment</b></p> <ul style="list-style-type: none"> <li>• <b>Newness</b></li> <li>• <b>Performance</b></li> <li>• <b>Customization</b></li> <li>• <b>“getting the job done”</b></li> <li>• <b>Design</b></li> <li>• <b>Brand/status</b></li> <li>• <b>Price</b></li> <li>• <b>Cost reduction</b></li> <li>• <b>Risk reduction</b></li> <li>• <b>Accessibility</b></li> <li>• <b>Convenience/usability.</b></li> </ul>	<p><b>4. Customer Relationships</b>          What type of relationship does each of our Customer Segments expect us to establish and maintain with them?           Which ones have we established?           How are they integrated with the rest of our business model?           How costly are they?</p> <p><b>Describes the types of relationships a company establishes with specific customer segments.</b></p> <ul style="list-style-type: none"> <li>• <b>Personal assistance</b></li> <li>• <b>Dedicated personal assistance</b></li> <li>• <b>Self-service</b></li> <li>• <b>Automated services</b></li> <li>• <b>Communities</b></li> <li>• <b>Co-creation.</b></li> </ul> <p><b>3. Distribution Channels</b>          Through which Channels do our Customer Segments want to be reached?           How are we reaching them now?           How are our Channels integrated?           Which ones work best?           Which ones are most cost-efficient?           How are we integrating them with customer routines?</p> <p><b>Describes how a company communicates and reaches its customer segments to deliver a value proposition.</b></p> <ul style="list-style-type: none"> <li>• <b>Own direct</b> – sales force, web sales.</li> <li>• <b>Own indirect</b> – own stores.</li> <li>• <b>Partner indirect</b> – partner stores, wholesaler.</li> </ul>	<p><b>1. Customer Segments</b>          For whom are we creating value?           Who are our most important customers?           What are our customer archetypes?</p> <p><b>Defines the different groups of people or organizations an enterprise aims to reach and serve.</b></p> <ul style="list-style-type: none"> <li>• <b>Mass market</b> – Focuses on one large group. Ex: consumer electronics</li> <li>• <b>Niche market</b> – Specific, specialized. Ex: car part manufacturers depend on major auto manufacturers</li> <li>• <b>Segmented</b> – Customer with slightly different needs and problems.</li> <li>• <b>Diversified</b> – Serves two unrelated customer segments. Ex. Amazon with books and then diversified.</li> <li>• <b>Multi-sided platforms or markets</b> – Two or more interdependent segments.</li> </ul>
<p><b>9. Cost Structure</b>          What are the most important costs inherent (built-in, underlying) in our business model?           Which Key Resources are most expensive?           Which Key Activities are most expensive?</p> <p><b>Describes all costs incurred to operate a business model.</b></p> <ul style="list-style-type: none"> <li>• <b>Cost-driven</b> – minimization of costs</li> <li>• <b>Value-driven</b> – focus on value creation. Ex. Luxury hotels.</li> <li>• Both can have characteristics such as:             <ul style="list-style-type: none"> <li>• <b>Fixed costs</b></li> <li>• <b>Variable costs</b></li> <li>• <b>Economies of scale</b></li> <li>• <b>Economies of scope</b></li> </ul> </li> </ul>		<p><b>5. Revenue Streams</b>          For what value are our customers really willing to pay?           For what do they currently pay?           How are they currently paying?           How would they prefer to pay?           How much does each Revenue Stream contribute to overall revenues?</p> <p><b>Represents the cash a company generates from each customer segments (cost must be subtracted from revenues to create earnings).</b></p> <ul style="list-style-type: none"> <li>• <b>Asset sale</b></li> <li>• <b>Usage fee</b></li> <li>• <b>Subscription fees</b></li> <li>• <b>Lending/renting/leasing</b></li> <li>• <b>Licensing</b></li> <li>• <b>Brokerage fees</b></li> <li>• <b>Advertising.</b></li> </ul>		

Table C1: Guided BMC Summary of Business Model Generation Book (Osterwalder & Pigneur, 2010, pp 1-44).

## APPENDIX D

**UPRM IRB Documents.** This appendix provides the following documents;

- **Protecting Human Research Participants Certificate of Completion**



- **Informed Consent Sheet for the Participants (in Spanish)**
- **Interviewee List (in Spanish)**
- **Guidance Questions for Interviews (in Spanish)**
- **UPRM IRB Approval Letters (in Spanish and English)**



Universidad de Puerto Rico  
Recinto Universitario de Mayagüez  
Colegio de Administración de Empresas  
Programa Graduado



Hoja de Consentimiento Informado para los Participantes

**Proyecto: *Development of Alternative Business Model for the Aeronautical and Aerospace Institute of Multidisciplinary Technologies in Puerto Rico***

Estimado Participante:

Se le invita a ser contribuyente de un investigación graduada conducida por la estudiante Edmée M. Cortés Valle. Esta, como parte de los requisitos de graduación del programa de maestría en Finanzas del Colegio de Administración de Empresas de la UPRM. Su contribución sería en forma de entrevista, esta ayudaría a arrojar un panorama más preciso y reafirmar información competente al dominio en el campo de uno o más temas que abarca la investigación para el desarrollo y aplicabilidad del modelo de negocios.

El propósito de esta porción de la investigación es documentar y comprender de forma más precisa en temas como la industria de aeronáutica en Puerto Rico, las operaciones y funcionamiento del Instituto de Aeronáutica y Aeroespacial de Puerto Rico junto con su proyectada División de Tecnologías Multidisciplinarias, el funcionamiento de las corporaciones subsidiarias universitarias en Puerto Rico, el desarrollo de propiedad intelectual en la UPR y la utilidad de la herramienta *Business Model Canvas* como instrumento para generar modelos de negocios. Como beneficio de participar en la investigación el entrevistado podrá utilizar la información recopilada y plasmada en la versión a ser publicada.

El tiempo de la entrevista fluctuaría entre 45 – 90 minutos. Se informa que su participación en la investigación no conlleva ningún riesgo, la misma es completamente voluntaria y con la alternativa de excluir datos de ser deseado por el entrevistado. La exclusión de datos por preferencia del entrevistado no tendrá repercusiones considerables dado que la información a recopilarse es para precisar y reafirmar con su opinión la data encontrada. Además, se le notifica de antemano que no se le requerirá que brinde ningún tipo de información personal, y se le comunica que la información obtenida durante la misma será utilizada, almacenada y controlada única y exclusivamente por el investigador (entrevistador) para fines del desarrollo de la esta investigación.

De no desear ser identificado durante la redacción del proyecto de investigación, tiene la oportunidad de indicarlo: \_\_\_\_ No deseo ser identificado \_\_\_\_ Deseo ser identificado.

De tener alguna duda siéntase en libertad de contactar al investigador responsable (entrevistador), Edmée M. Cortés Valle al (787) – 453 – 9706 o [edmee.cortes@upr.edu](mailto:edmee.cortes@upr.edu). Si desea puede contactar al Dr. José I. Vega Torres, Presidente del Comité Graduado del Investigador responsable de esta investigación al (787) – 832 – 4040 Ext. 5591/3613 o [jose.vega18@upr.edu](mailto:jose.vega18@upr.edu). En adición, se puede contactar con el Comité para la Protección de Seres Humanos en la Investigación al (787)–832–4040 Ext. 6277 o [cpsbirum@uprm.edu](mailto:cpsbirum@uprm.edu).

\_\_\_\_\_  
Nombre del Participante a Entrevistar

\_\_\_\_\_  
Firma del Participante a Entrevistar

\_\_\_\_\_  
Fecha

\_\_\_\_\_  
Firma del Entrevistador

\_\_\_\_\_  
Fecha



Universidad de Puerto Rico  
Recinto Universitario de Mayagüez  
Colegio de Administración de Empresas  
Programa Graduado



Procedimiento de Ejecución de Entrevistas y Listado Preliminar de Personas a Entrevistar  
**Proyecto: *Development of Alternative Business Model for the Aeronautical and Aerospace Institute of Multidisciplinary Technologies in Puerto Rico***

**Entrevistador:** Edmée M. Cortés Valle, estudiante graduada

De ser consentido, se estarán entrevistando las siguientes personas para corroborar hallazgos y coleccionar data que solo personal experto podría ofrecer para esta investigación. Cada persona indentificada a ser entrevistada se encuentra bajo el tema que sería su enfoque/área de experiencia individual aunque dependiendo el área de enfoque del entrevistado, este, podría vislumbrar información clave dentro de más de un segmento objetivo. Las áreas de enfoque son;

**Industria Aeroespacial**

1. [REDACTED] Director Ejecutivo de PRTEC, Tesorero de Puerto Rico Aerospace Technology Consortium (cluster). También funge como validación del BMC como herramienta y Corporaciones Subsidiarias. [C]
2. [REDACTED] Aerospace, Defense and Industrial Services Specialist III at Infotech Aerospace Services [E]
3. [REDACTED] – Microwave and Telecommunications Head Branch at NASA GSFC [D]
4. [REDACTED] Power Systems Branch NASA GSFC [L]

**Funcionarios UPR y Corporaciones Subsidiarias**

5. [REDACTED] Coordinador de la OPPITT del Colegio de Ingeniería en el RUM [A]
6. [REDACTED] Profesor y Director Ejecutivo de AAIPR, Inc. [B]
7. [REDACTED] Profesora Ing. Mecánica, Directora Center for Aerospace and Unmanned Systems Engineer (CAUSE) [K]

**Investigadores que utilizan fondos federales/públicos**

8. [REDACTED] Director NOAA - RUM y Lab de Oceanografía Bio-Óptica en Isla Magueyes. [G]
9. [REDACTED] Profesor e investigador con fondos federales y de otras fuentes. [H]
10. [REDACTED] Space Weather Senior Forecaster, Space Weather Laboratory at NASA GSFC. Former Professor, Teached (2004-13) for which 04-07 was in UPRM, Physics Department. También parte de Industria Aeroespacial. [F]

**Validación para aplicabilidad de BMC como herramienta**

11. [REDACTED] Oficial Administrativo de Ingeniería. Accounting for Engineers Professor. Also works with Viride, Inc. [J]
12. [REDACTED] Industrial Engineer Professor. Medical Devices Empresarismo en Ing. Industrial [I]

Dado cambios en este listado, se le estará notificando al Comité para la Protección de los Seres Humanos en la Investigación para debida aprobación.





Universidad de Puerto Rico  
Recinto Universitario de Mayagüez  
Colegio de Administración de Empresas  
Programa Graduado



Preguntas Guías para Entrevistas  
**Proyecto: *Development of Alternative Business Model for the Aeronautical and Aerospace Institute of Multidisciplinary Technologies in Puerto Rico***

**Propósito:** Desarrollar modelos de negocios alternativos para la Division de Tecnologías Multidisciplinarias del Instituto de Aeronáutica y Aeroespacial en Puerto Rico. Utilizando la herramienta del Business Model Canvas y evaluando la particularidad del Instituto se espera desarrollar varios modelos de negocios alternativos para la sostenibilidad económica de la Division y, a su vez, del Instituto. Los segmentos objetivos identificados para el modelo de negocio alternativo están descritos en la sección (1). Dependiendo el área de enfoque del entrevistado, este, podría vislumbrar información clave dentro de más de un segmento objetivo. Los modelos serán presentados a la gerencia de la Corporación (Instituto) como una utilidad de evaluación de la empresa. Adelante se encuentran áreas de enfoque de los candidatos a entrevistar. La organización de este documento consiste en (10) partes. Cada parte comienza con una breve explicación de la misma seguido de las preguntas identificadas por área de enfoque.

A = Industria de Aeronautica  
B = Funcionarios UPR y Corporaciones Subsidiarias  
C = Investigadores  
D = Usuarios del BMC en cualquier área de enfoque anterior

**1**

Segmentos objetivos identificados:

- Clientes corporativos/privados sea locales o internacionales que esten interesados en desarrollar proyectos de investigación y desarrollo en la industria de aeronáutica y aeroespacial en Puerto Rico y que a su vez traiga crecimiento en dicha industria.
- Proyectos de investigación y desarrollo por investigadores universitarios con fondos federales o públicos
- Proyectos de investigación y desarrollo por investigadores universitarios con otra fuente de fondos, sean fondos privados o mixtos (federales/públicos y privados).

A/B/C. ¿Cree usted que los segmentos previamente identificados sean los mas adecuados para el propósito final de la división? ¿Por qué? ¿Qué otro segmentos recomendaría?

B. Como funcionario experto, ¿Cual es el segmento que se le da mayor énfasis en la subsidiaria/oficina que usted labora? ¿Cómo se comparan?

C. ¿Qué método de investigación usted utiliza con más frecuencia, referente a los segmentos? (sea corporaciones que le hacen el acercamiento para un proyecto, iniciativa propia de desarrollar un proyecto sea con fondos federales y/o privados) ¿Por qué? ¿hay algún método que quiera usar y no haya tenido la oportunidad?

**2**

Explicando el valor de lo que ofrece el Instituto:

- Creación de facilidades de investigación y desarrollo que servirá como un hub en la industria de aeronáutica y aeroespacial para la concentración geográfica que abarcaría Puerto Rico en el hemisferio facilitando la tecnología para las agencias o compañías de la industria con los niveles más altos de calidad guiados por estándares Federales y Alemanes.
- Personal capacitado en temas de transferencia de tecnología, propiedad intelectual y proceso de comercialización para orientación y servicios de estos en la industria.

- Prestigio UPR con reputación mundial en disciplinas STEM

A/B/C. ¿Qué otro uso (para propósitos de valor/ofrecimiento) podría estar dando la División?

A/B/C. Dado lo que usted ha experimentado en la industria/oficina/subsidiaria o como investigador; ¿Cuál proposición de valor/ofrecimiento opina tiene el mayor peso en AAIMT?, ¿Por qué?, ¿qué otra cosa AAIMT podría estar haciendo para variar o mejorar esta proposición de valor/ofrecimiento?

B/C. ¿Usted como funcionario UPR/Corporaciones Subsidiarias o Investigador ve esta proposición de valor/ofrecimiento como adecuada para este ámbito/industria?

C. ¿Cuáles son las cosas básicas (ambiente, work space, tools, offering) que considera mas importante cuando decide desarrollar un proyecto?, ¿hay algunas que coincidan con la oferta de AAIMT?, ¿Cuáles consideraría serian recomendables añadir?

### 3

Vías para llegar al cliente:

- Convenciones de la industria, visitas de agencias Federales para acuerdos o por invitación del Director. Expos mundiales (Hannover Messe, Select USA).
- Arreglos con algunas compañías o departamentos de las mismas (Lufthansa, Honeywell).
- Website oficial, correos electrónicos, noticias, redes sociales.

A/B/C. ¿Qué otras vías para llegar al cliente (Corporaciones, Investigadores) recomienda?

A/B/C. ¿De qué forma habría que darse a conocer para generar exposición y atraer clientes?

A/B/C. Al momento de hacer un proyecto, ¿Busca patrocinadores?, ¿Busca espacio de trabajo?

A/B/C. ¿Entidades le hacen acercamiento para esto o para un tema de proyecto específico?

A/B/C. Si es usted mismo (sea Corporación o Investigador), ¿Cuál es la manera en que se puede encontrar los patrocinadores/fondos o lugares de trabajos (expos, convenciones, alguna entidad específica, u oficina sea local o federal), ¿Qué consigue en cada una? ¿Cuáles son con las que mas se relaciona?

B/C. De ser diferentes; ¿Cuales son las maneras de llegar a sus respectivos clientes de las divisiones de la UPR que sean similares a esta?

### 4

Relación con los diferentes clientes:

- La relación con los clientes debe ser una dedicada y específica a las necesidades del mismo. Esta dependerá del equipo, proyecto y objetivo del cliente.
- Los clientes locales podrían tener la ventaja por la proximidad.

A/B/C. ¿Cómo debería ser la relación entre la División y el cliente?, ¿Cómo usted cree cambiaria esta relación con los diferentes segmentos (Corporaciones, Investigadores).

B/C. Cuando trabajando con alguna entidad, usualmente, ¿Qué tipo de relación se mantiene?, ¿se comunican constantemente durante la duración del proyecto?, ¿es algo que se estipula al comienzo del proyecto?

C. Usted como investigador, siendo potencial cliente de entidades similares o por experiencias anteriores, ¿Cómo espera sea la relación con la gerencia del instituto y el equipo de trabajo?

### 5

Un ejemplo de donde sacaran fondos;

- Servicios de Investigación y Desarrollo para la industria de Aeronautica y Aeroespacial (sea uso de facilidades, o recursos humanos).

- Desarrollo y protección de propiedad intelectual
- Licencias para uso de tecnología desarrollada (dependerá del acuerdo pre estipulado). Venta de activos.

A/B/C. Dada su experiencia, estimando de 1-5 años, dentro lo que ofrece o podría ofrecer el Instituto/División; ¿Cuales serian ejemplos reales de flujo de ingresos, revenue streams?.

A/B/C. ¿Cuál de los mencionados puede ser una fuente estable de ingreso?; ¿Alguna fuente de ingreso estable que no se haya mencionado?

A/B/C. Dado lo mencionado anteriormente, ¿cree la oferta de AAIMT tenga el potencial de generar flujos de ingresos (revenue) considerables para sus objetivos de crecer y ser hub en esta área?

## 6

Recursos AAIPR y UPR-Ag:

- Físicos – Apoyo de UPR-Ag, facilidades y equipos de AAIPR, construcción de facilidades AAIMT y obtención de equipo para investigación y desarrollo para desarrollar y mantener las relaciones con los clientes.
- Intelectuales – Desarrollo de nuevas tecnologías. Oficina de Transferencia de Tecnologías en UPRM como socio potencial para conocimiento de protección sobre generación de propiedad intelectual.
- Humanos – Investigadores y profesores cualificados en el campo. UPR-Ag provee servicios de contabilidad, finanzas, colecturía, compras, propiedad y oficina de recursos humanos. AAIPR provee gerencia y apoyo directo.
- Financieros – Apoyo de la industrias y sus necesidades para el continuo desarrollo. Apoyo inicial de entidades gubernamentales y federales para creación de la división.

A/B/C. ¿Cuales son los recursos (físicos, intelectuales, humanos o financieros)?

Recurso(s) más importante(s) en el ofrecimiento:

Recurso(s) más importante(s) para llegar al cliente:

Recurso(s) más importante(s) en la relación con el cliente existente:

Recurso(s) más importante(s) para que haya flujo de ingresos:

C. Cuando usted trabaja con un proyecto, ¿qué recursos considera más importantes (físicos, intelectuales, humanos o financieros)?, ¿Por qué?; ¿aplicaría para el instituto?

## 7

Actividades para el funcionamiento:

- Creación de las facilidades de AAIMT, mantener las facilidades de AAIPR para proveer servicios de investigación y desarrollo requeridas para que la industria mantenga competitividad y sobresalir.
- Mantener el contenido de ofrecimientos actualizado; revisar sociedades y acuerdos para beneficios mutuos.
- Constante comunicación y reacción de los clientes para éxito de proyectos y demás servicios.

A/B/C. ¿Qué debe ser lo más importante que el Instituto/División debe hacer para que el modelo de negocio funcione? (aparte de facilidades), ¿Por qué?. Si no es de lo ya propuesto: ¿Cómo se puede incorporar esa actividad para que funcione en el modelo de negocios?

B/C. Usted como investigador, cuando tiene un proyecto, ¿qué actividades considera más importantes?

B/C. ¿Sobre que actividades usted suele encargarse para que el proyecto de frutos en términos de negocios (producción, resolver problemas, actividades de distribución)? Sino ha llegado a esta etapa: ¿Cuál es la razón de no llegar a esta etapa?, ¿Falta de interés?, ¿Obstáculos (¿Cuáles?)?, ¿Qué es lo mas que se ha acercado a la misma?.

## 8



Socios que ayudan al modelo de negocios:

- Públicos – Gobierno de Puerto Rico, Universidad de Puerto Rico y Departamento de Educación creación y apoyo AAIPR; Puerto Rico Industrial Development Company.
- Federales – Federal Aviation Administration otorgo certificaciones de cumplimiento a enseñanza de regulaciones de aviación, Economic Development Administration se sometió una propuesta para obtención de fondos parciales para creación de facilidades de AAIMT. Potenciales: Office of Transportation Affairs, USA Department of Commerce, Department of Defense, Transportation Security Administration.
- Privados locales: Lufthansa Technik de Puerto Rico – apoyo para creación AAIPR; Honeywell y Avenger – utiliza facilidades de AAIPR para entrenamientos. Potenciales: Puerto Rico Techno – Economic Corridor.
- Agencias Independientes – National Aeronautics and Space Administration – Visita de Glen Research Center para potencial sociedad; National Science Foundation; Small Businesses Administration. Potenciales: National Transportation Safety Board.

A/B/C. ¿Qué otra alianza pudieran hacer?; ¿Algún ejemplo de alianzas exitosas?; ¿Cómo funcionaría una alianza que permita a este modelo de negocios funcionar para que la división logre sus objetivos?

B/C. Usualmente, ¿qué tipo de entidades de apoyo o partners suele tener cuando hace investigaciones o toma proyectos?; ¿privados?, ¿públicos?, ¿Agencias independientes?; ¿De cuáles se beneficia más?

## 9

Gastos y costos:

- Recursos físicos – Creación de edificio/facilidades para la división y adquirir equipo necesario para el funcionamiento.
- Recursos humanos – el costo dependerá de la educación y obligaciones del investigador y/o su equipo de trabajo.
- Mantenimiento de los servicios para ofrecer y proyectos de investigación y desarrollo.
- Proyecto de investigación y desarrollo que no genere los resultados de flujo de efectivo esperado y el Instituto absorba esos costos.

A/B/C. Aparte de las facilidades y equipo, ¿qué suele ser lo más costoso en cuanto a recursos?

Usualmente, ¿qué es lo más costoso en cuanto a actividades?

A/B/C. ¿Qué costos suelen ser no tomados mucho en cuenta (inherentes) y luego resultan dispararse?

B/C. Cuando se encarga de un proyecto, ¿cómo de distribuye la estructura de gastos/costos?; ¿se enfoca en calidad y valor (de la tecnología), en la minimización de costos o en ambos?. En proyectos pasados, ¿ha tenido que sacrificar alguna de estas?, ¿Cómo resolvió esa situación?. ¿recomienda lo mismo en el caso del instituto?, (si: ¿Qué opina sea un costo que se pueda sacrificar para el instituto?) (no: ¿qué recomienda?)

## 10

Preguntas adicionales al azar:

¿Han tenido productos o tecnologías que hayan generado sostenibilidad económica y/o crecimiento para la corporación?; ¿Qué técnica para generación de ingresos ha sido más efectiva?

¿han protegido intelectualmente las creaciones? ¿Cómo ha sido el proceso?

Problemas o beneficios que hayan enfrentado por la asociación a la UPR.

¿Cuál es el estimado en tiempo de concepción de proyecto a fabricación de producto dentro de la UPR?

¿Cuanto adicional para fabricación en masa del producto?

**Estas preguntas están sujetas a cambios y expansión con la debida aprobación del Comité para la Protección de los Seres Humanos en la Investigación**



**Comité para la Protección de los Seres Humanos en la Investigación  
CPSHI/IRB 00002053**

Universidad de Puerto Rico – Recinto Universitario de Mayagüez  
Decanato de Asuntos Académicos  
Call Box 9000  
Mayagüez, PR 00681-9000

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18 de octubre de 2017

Edmée M. Cortés Valle  
Administración de Empresas  
RUM

Estimada Edmée Cortés Valle:

El Comité para la Protección de los Seres Humanos en la Investigación (CPSHI) ha considerado su Solicitud de Revisión y demás documentos sometidos para el estudio ***Development of Alternative Business Model for the Aeronautical and Aerospace Institute of Multidisciplinary Technologies in Puerto Rico (Protocolo 201710XX)***.

Su proyecto cualifica para un proceso expedito de aprobación bajo la categoría 7 del 45 CFR 46.110. Luego de evaluarlo, el comité determinó que este estudio no supera el nivel mínimo de riesgo y cumple con todos los requisitos de protección de seres humanos según definidos por la reglamentación federal 45 CFR 46. Por tanto, aprobamos su investigación. La aprobación tiene vigencia de un año a partir de hoy; esto es, desde el 18 de octubre de 2017 hasta el 17 de octubre de 2018. Le recordamos que la aprobación emitida por nuestro comité no lo exime de cumplir con cualquier otro requisito institucional o gubernamental relacionado al tema o fuente de financiamiento de su proyecto.

La reglamentación federal exige que nuestro comité supervise toda investigación mientras continúe activa. Se consideran activos aquellos proyectos que aún estén reclutando participantes o haya terminado el reclutamiento pero aún se estén recopilando o analizando datos. Si vislumbra que su proyecto seguirá activo al momento de vencerse la fecha de aprobación, le pedimos que someta una solicitud de extensión a más tardar un mes antes del vencimiento de su vigencia.

Le recordamos que debe utilizar la hoja de consentimiento informado sometida y aprobada por el Comité. Le agradeceremos utilice estos documentos para los trámites correspondientes de su investigación. Le recordamos que debe entregarle una copia de la hoja de consentimiento informado a todos/as los/as participantes que acepten ser parte de su estudio.

Cualquier cambio al protocolo o a la metodología deberá ser revisado y aprobado por el CPSHI antes de su implantación, excepto en casos en que el cambio sea necesario para eliminar algún riesgo inmediato para los/as participantes. El CPSHI deberá ser notificado de dichos cambios tan pronto le sea posible al/a la investigador/a. El CPSHI deberá ser informado de inmediato de cualquier efecto adverso o problema inesperado que surgiera con relación al riesgo de los seres humanos, de cualquier queja sobre esta investigación y de cualquier violación a la confidencialidad de los participantes.

Cordialmente,

Dr. Rafael A. Boglio Martínez  
Presidente  
CPSHI/IRB

**Teléfono:** (787) 832 - 4040 x 6277, 3807, 3808 – **Fax:** (787) 831-2085 – **Página Web:** [www.uprm.edu/cpsbi](http://www.uprm.edu/cpsbi)  
**Email:** [cpsbi@uprm.edu](mailto:cpsbi@uprm.edu)



**Institutional Review Board**  
**CPSHI/IRB 00002053**  
University of Puerto Rico -- Mayagüez Campus  
Dean of Academic Affairs  
Call Box 9000  
Mayagüez, PR 00681-9000



January 11, 2017

Edmee Cortes Valle  
Finance  
Business Administration  
RUM

Dear student:

As a member of the Institutional Review Board of the University of Puerto Rico - Mayagüez Campus, I have considered the Review Application for your project titled **Development of Alternative Business Models for the Aeronautical and Aerospace Institute of Multidisciplinary Technologies in Puerto Rico** (Protocol num. 20170103). After an evaluation of your protocol, I have determined that your research qualifies for an exempt approval according to Category 2 of 45.CFR.46.101(b).

Remember that any modifications or amendments to the approved protocol or its methodology must be reviewed and approved by the IRB before they are implemented. The IRB must be informed immediately if an adverse event or unexpected problem arises related to the risk to human subjects. The IRB must likewise be notified immediately if any breach of confidentiality occurs.

We appreciate your commitment to uphold the highest standards of human research protections and remain.

Sincerely,

Dr. Rafael A. Boglio Martinez  
President, Institutional Review Board (IRB)  
University of Puerto Rico,  
Mayagüez Campus  
Office: Celis 108  
Tel.: (787) 832-4040 Ext. 6277  
Web Page: <http://www.uprm.edu/cpshi/>

## APPENDIX E

**Code Book Manual.** This appendix contains the code book manual used for identifying common themes and statements arising from the interview process.

### 1. The BMC

- a. **BMC tool** – Statements demonstrating the use, versatility, and adaptability of the BMC.

Keywords: BMC use, versatility, adaptability

### 2. Building Blocks

- a. **Customer Segments** – Topics related to the different groups of customer segments identified by management, subdivisions. Duration of projects, difficulty obtaining funds for projects/sponsorship
  - i. **Projects** – Statements made about different kinds of possible projects or subdivisions that could be done.

Keywords: possible projects, subdivisions, funding difficulty, duration of projects, variation of project length

- b. **Value Proposition** – Statements made regarding the value the division could bring. Incentives and regulation compliances (ITAR). Location. Current offerings.

- i. **Services Offering** – Statements about the projected offering.

- ii. **Research Clusters Identified** – Materials Science Technologies, Atmospheric Sciences, Navigational and Positional Technologies, Propulsion Technologies and Human Factors Research, Unmanned Vehicles

- iii. **Added Value Factors** – Any characteristic mentioned which would add value to the AAIMT or their projected service offering.

Keywords: R&D, TT&C and IP development component, research clusters, location, regulations compliance, potential incentives, UPR sought engineers.

- c. **Distribution Channels** – Includes topics concerning the means of attracting companies and/or researchers. Statements made about the status of the AAIC in Puerto Rico, Globally, and the UPR. Statements about how to engage the customer segments and project sponsors.

Keywords: reach to the AAIC, local and global players, academia

- d. **Customer Relationships** – Statements concerning the different degrees of involvement between the Division and the client.

- i. Dedicated personal assistance – individualization for attending customer needs such as special assistance or flexibility.
  - ii. Co-creation – creating value with the AAIMT of in their facilities involves agreements or contracts.

Keywords: assistance, flexibility for the customer, types of agreements, contracts.

**e. Revenue Streams** – Statements made about income generation for the sustainability of the Division. Factors that could affect the income generation. Charging fees for services to be provided (one, various, or all of: facilities, equipment, researcher, research team, IP developed, TT&C), licensing and royalty fees of long term IP generation, and the impact from the relation of the UPR with the Division. (commercialization path & table 3 also falls here).

Keywords: fees for services provided, licensing, royalty fees, long term IP generation, impact of relation UPR.

**f. Key Resources** – The most essential resources to make the business model work.

**i. Physical** – Statements made about the need or use of facilities and equipment

**ii. Intellectual** – Statements made about the generation of IP, brands, partners

**iii. Human** – Statements made about the personnel required

**iv. Financial** – Statements made about the funding options to operate the facilities

Keywords: laboratories, potential IP, strategic partnerships, researchers, research team, operational staff, funding options, internal projects, customer segment projects, EDA grant, motivation for researchers.

**g. Key Activities** – Statements concerning the Institute activities required within the value side to make the business model work. Such as providing services in a timely manner, constant communication with client, review of alliances and relations with the industry, importance of the facilities maintenance, academic accreditations compliance, and aviation regulations compliance

Keywords: length of project, accessibility of facilities, industry relations, alliances and inter-agreements, maintenance of facilities, regulations and accreditations compliance.

**h. Key Partners** – Statements regarding current and future possible partners who will contribute to the business model to work. This relates to resources obtained from partners or to activities that partners perform instead of the Division performing them.

Keywords: industry players, Federal and local Government entities, subcontracted services.

**i. Cost Structure** – Statements made about all the possible costs related to make the business model work. It includes themes within physical resources, human resources, and outliers affecting the cost structure, or cost of projects.

Keywords: facilities, laboratory, equipment, vehicles, wages, personnel, outliers, UPR strikes, natural disasters, market shifts, legal services, office administrators, utilities, maintenance, researcher, research team.

## APPENDIX F

**UPR Pertinent Policies and Possible Incentives for AAIMT/AAIPR.** This appendix provides the table of content list of the binder created containing UPR pertinent policies and possible incentives for the Division and/or Institute.

Table of Content		
UPR Pertinent Policies and Possible Incentives for AAIMT/AAIPR		
Sections	Source, Num. and/or Year	Title
<b>Section 1: UPR Plans</b>	The Board of Trustees Cert. No. 50 (2016-2017)	Plan Estratégico 2017-20122 de la UPR: Una Nueva Era de Innovación y Transformación para el Exito Estudiantil
	The Board of Trustees Cert. No. 29 (2017-2018)	UPR Fiscal Plan for 2018-2026
<b>Section 2: Intellectual Property and Technology Transfer</b>	The Board of Trustees Cert. No. 132 (2002-2003)	Institutional Policy on Patents, Inventions and Their Commercialization
	The Board of Trustees Cert. No. 18 (1991-1992)	Política Institucional Sobre Patentes e Invenciones (no aparece Derogada)
	President of the UPR Circular Letter R-0304-17	Patent Commercialization Net Income Distribution
	Council on Higher Education Cert. No. 93-140 The Board of Trustees Cert. No. 140 (1992-1993)	Institutional Policy Regarding Intellectual Property Política Institucional Sobre Derechos de Autor
	President of the UPR Circular Letter No. 95-01	Reproductions of Works Protected by Copyright Laws
	Vice Presidency for Research and Technology	UPR Invention Disclosure Form
		Invention Disclosure (ID), Option, Assignment and Invention Management Summary of Alternatives
	The Board of Trustees Cert. No. 96 (2016-2017)	Policy on Patrimonial and Moral Author Rights in the UPR
	The Board of Trustees Cert. No. 97 (2016-2017)	Policy on Patents, Inventions, and their Commercialization in the UPR - (Proposal pending approval)
<b>Section 3: Overarching Research Policies and Procedures</b>	Office of the Vice President for Research and Technology – March 9, 2012	Handbook of Policies and Procedures for Sponsored Programs
	The Board of Trustees Cert. No. 036 (2009-2010)	Institutional Policy for Obtaining, Using, and Controlling External Funds to be Received by the UPR Educational Programs, Research and Public Service
	The Board of Trustees Cert. No. 037 (2009-2010)	Institutional Policy for the Request and Acceptance of Private Donations
	The Board of Trustees Cert. No. 45 (2006-2007)	System-Wide Policy and Procedures for Responding to Allegations of Possible Misconduct of the UPR
<b>Section 4: Time and Effort Reporting</b>	The Board of Trustees Cert. No. 14 (2011-2012)	Policy for the Promotion and Development of Research at the UPR
	The Board of Trustees Cert. No. 15 (2011-2012)	Effort Reporting Policies and Procedures at the UPR
	The Board of Trustees Cert. No. 16 (2011-2012)	Cost Sharing/Matching Funds Policies and Procedures at the UPR
	The Board of Trustees Cert. No. 49 (2012-2013)	Amendments for Certs. No. 14, 15, and 16 (2011-2012)
	President of the UPR Circular Letter R-1112-21	Rules of Promotion of Research Development, and Time and Effort Reporting in Accordance with Certs No. 14 and 15 (2011-2012)
	Oficina del Rector, Profesores e Investigadores RUM	Apertura del Proceso para Solicitar Diferenciales de Salario Base Docente
	President of the UPR Circular Letter R-1112-35	Procedures for the Preparation of Time and Effort Reporting in the University System
	President of the UPR Circular Letter R-1112-36	Implementation of the Policy for the Promotion and Development of Research at the UPR for Professorate with Administrative Duties Doing Research During the Summer Period
	President of the UPR Circular Letter R-1213-05	Incidental Expenses Requiring Prior Authorization by External Agencies Sponsoring Projects or Programs at the UPR
	President of the UPR Circular Letter R-1213-06	Billing Period for External Agencies Sponsoring Projects or Programs at the UPR
	Form – 125A	Time and Effort Report for Establishing Payroll distribution
	Form – 125B	Time and Effort Certification Report
	CID, UPRM Nov 12, 2013	Workshop: Preparation of Form 125A Report for Facilitating Payroll Distribution

<b>Section 5: Conflict of Interest</b>	The Board of Trustees Cert. No. 8 (2012-2013)	Policy and Guidelines for Financial Conflicts of Interests and Commitments in Research and Sponsored Programs of the UPR
	The Board of Trustees Cert. No. 12 (2015-2016)	Amendment of Cert. No. 8 (2012-2013), Art VII, Sec F.2
	Form 1.A & 1.B	Disclosure of Investigator's Significant Financial Interest
	Form 2.A	Financial Conflict of Interest Annual Disclosure
	Form 2.B	Financial Conflict of Interest Disclosure Attachment
<b>Section 6: Institutional Research and Research Institutes</b>	The Board of Trustees Cert. No. 108 (1998-1999)	UPR Policy on Institutional Research
	The Board of Trustees Cert. No. 023 (1996-1997)	Policy to Establish Multidisciplinary and Multicampus Research Institutes
	The Board of Trustees cert. 081 (1996-1997)	Amendment for Cert. No. 023 (1996-1997)
	The Board of Trustees Cert. 144 (1996-1997)	Strategic Plan for Science and Technology at the UPR
	The Board of Trustees Cert. No. 106 (2016-2017)	Política de Incentivos Institucionales para el Docente Involucrado Activamente en Proyectos Subconvencionados con Fondos Externos en la UPR
<b>Section 7: Plan de Práctica Intramural Universitaria</b>	The Board of Trustees Cert. 123 (1996-1997)	Reglamento Para la Creación y Administración de Planes de Práctica Universitaria Intramural en la UPR
	124 (1996-1997)	Enmienda al Reglamento General de la Universidad al Art. 68, 69, y 100 para incluir Plan de Práctica Intramural
	126 (1996-1997)	Plan de Retribución Personal No Docente – Diferencial (enmienda a Cert. 123 (1996-1997))
	144 (2002-2003)	Otorgamiento de Grados en Centros de Extensión y PPI
	P. del S. 1361	Ley 174 del 31 de agosto de 1996
	Administración Central UPR	Manual de Procedimientos para Plan de Práctica Universitaria Intramural
	Bajo UPRM Solamente	Directrices del Plan de Práctica Intramural Universitaria del RUM (PPIUM)
		Reglamentación del Plan de Práctica Intramural Universitaria en el RUM
		Procedimiento para la Preparación y Radicación de Propuestas bajo PPIUM
		Guía Básica para la Preparación de Propuestas PPIUM
		PPIUM Contract for Corporate Entity
<b>Section 8: Aguadilla</b>	Junta Administrativa UPR-Ag Cert. No. 2012-13-61	Plan Estratégico 2012-2017 de la UPR en Aguadilla
	Junta Administrativa UPR-Ag Cert No. 2015-16-54	Reglamentación sobre Auspicios de Promoción a Empresas y Negocios de la UPR-Ag
	Junta Administrativa UPR-Ag Cert. No. 2014-15-41	Formulario – Justificación para Contratar por Servicios Profesionales de la UPR en Aguadilla
	The Board of Trustees Cert. 113 (2014-2015)	
	Junta Administrativa UPR-Ag Cert No. 2014-15-50	Presupuesto para el Establecimiento de un Programa de Grado Asociado en Tecnología de Aeronáutica y Aeroespacial
<b>Section 9: AAIPR, Inc</b>	The Board of Trustees Cert. No. 94 (2013-2014)	Creación AAIPR, Inc.
	The Board of Trustees Cert. No. 100 (2014-2015)	Creación G.A. en Tecnología Aeronáutica y Aeroespacial de la UPR en Aguadilla
	The Board of Trustees Cert. No. 17 (2015-2016)	Creación Subcomité sobre las Corporaciones Subsidiarias de la UPR
	The board of Trustees Cert. No. 71 (2015-2016)	Cambio de Nombre del Bachillerato en Ciencias en Tecnología Electrónica de la UPR en Aguadilla
	The Board of Trustees Cert. No. 45 (2017-2018)	Designación de Representante de la Junta de Gobierno Ante Junta de Directores de AAIPR, Inc.
<b>Section 10: Leyes avaladas por UPR</b>	Ley Núm. 20 de 17 de Enero de 2012	Ley Para Fomentar la Exportación de Servicios
	Departamento de Desarrollo Económico y Comercio	Explicación de Ley Núm. 20 de 17 de enero de 2012
	Ley Núm. 101 de 27 de Junio de 2008	Eximir de tributación los salarios devengados y compensación recibida por investigadores científicos elegibles que realicen investigaciones en PR en institución superior bajo parametros de NIH
	Comunicado Vicepresidencia de Investigación y Tecnología UPR	Información actualizada sobre sttus del proceso de implantación de Ley 101 de 27 de junio de 2008
	Administración Central UPR, Oficina de Asuntos Legales	Ley Núm. 101 de 2008 – Incentivo Contributivo a Investigadores Científicos
	Comunicado UPR	Procedimiento para determinar si se es elegible para exención contributiva bajo Ley Núm. 101 de 2008