# USING WORDCLOUDS TO DEFINE AN INNOVATIVE BUSINESS MODEL FOR HVAC INDUSTRY IN BUILDINGS IN THE TERTIARY SECTOR

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***Abstract*— This study identifies the main characteristics of the standard business models of the HVAC (Heating, Ventilation and Air Conditioning) sector worldwide, specifically those whose value proposition is related to the supply, commercialization and sale of weatherization services through the use of clean and efficient technologies. All of the above in order to define a proposal for an innovative business model adapted to the Colombian context that contributes to the construction of projections at the scales of consumption of air conditioning, with their respective implications for energy and tariff consumption. This research was conceived Inquiring in business and scientific databases, field work and other secondary sources.**

**Keywords- Technological surveillance, competitive intelligence, HVAC, competitiveness, business model innovation**

## I. INTRODUCTION

The dynamics of global growth, technological development and its massification have influenced the spread of energy consumption and CO2 emissions in the environment and have led to the creation of energy efficiency and savings strategies, which has become a top priority objective of energy policies in most countries [1]. Several studies analyze the correct use of energy in buildings [2] because they account for about 40% of total final energy consumption [1], [3]-[6] and are responsible for a third of the global greenhouse effect of gas emissions.

In Colombia, the residential sector represents approximately 20% of the final energy consumption in the country. Some studies have shown that mini split-type air-conditioning systems represents a 86% share of total energy consumption in a building of the tertiary sector and that it is possible to generate a potential reduction in annual energy demand [7], [8] , A relevant factor in other sectors such the industrial or secondary sector [9], [10].

The business model is the representation of the company approach to combine strategies, resources and infrastructure in order to create, capture and transfer value propositions to its customers [11] - [15]. Hence innovation in the business model is not only oriented towards the survival of the company, but also to acquire a greater participation in the market, delivering value to the customer and receiving income in return [16], [17], this implies more than product or process innovation, since it involves changes in the value proposition to the client, especially in the process of creation, capture and value transfer [18].

Regarding to the characterization of business models, a specific search was conducted to identify previous studies oriented to sectors such as telecommunications, publishing, creative economy, advertising, technology, transportation and the banking sector, among others [19] - [26] With respect to the HVAC and/or energy efficiency sector, the results are oriented towards

energy-saving programs for buildings [27] - [30], while a few of them are directly related to the characterization or construction of business models in the sector [31] - [33]

## II. METHODOLOGY

For the development of this study, an information search was conducted for companies belonging to the HVAC sector at an international level, segmenting information by the following regions: Europe, the United States, Asia, Latin America and the Caribbean. Taking into account that those territories are the places where the largest producers and service providers of the tertiary sector are located, from multinationals to small and medium-sized enterprises (SMEs). In order to identify the companies, an in-depth analysis of the information provided from sector reports was made [34] - [36], the parameters defined to make the selection are related to location, target market, available information, type of company, size, reference to the use of clean and efficient technologies, among others. This procedure resulted in the selection of 124 companies. To facilitate the setting-up of the business model, the advice of the national experts in the HVAC sector involved in the project were crucial to the identification of fundamental aspects. Additionally it was possible to conduct interviews in companies located in Barranquilla, Colombia in order to validate the business model and the offered value proposition towards the client.

From the built database, using Microsoft Office´s Excel®, the information was filtered in order to remove names, pronouns, adjectives, prepositions, adverbs, etc. And consolidate the most representative words related to the value proposition of companies. From the obtained results the *WordClouds* are constructed [37] - [39] using the tool available at the website www.worditout.com, the output from this tool is an image that highlights the words that have been frequently used in the text, showing them in a larger size in an intense color tone.

With the results obtained from the analysis of the considered information using the tool *WordClouds*, a business model is proposed, initially validated by the experts mentioned above, without ceasing to be a set of hypotheses, for which an initial validation was carried out with the segment of clients identified through interviews with the staff in charge of clinics and universities in the management of HVAC equipment and oriented towards the use of clean and efficient technologies. The process used for the construction of *WordClouds* is presented in figure 1.

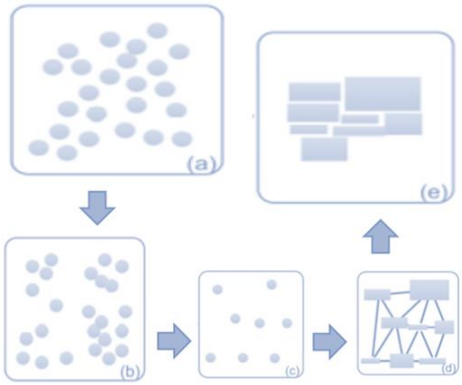


Figure 1: Methodology for creating WordClouds used for the study

The process is adapted from [40], and begins with the extraction of an initial set of words from the databases of the companies in the sector (a), then the extracted words are placed on a 2D plane by means of multidimensional scaling (b), a filtering of non-words related for a given time interval where names, pronouns, adjectives, prepositions, adverbs is carried out to eliminate them (c) , the remaining words are triangulated and finally the optimization of the distribution is obtained by means of a directed force algorithm, proper of the tool used.

## III. RESULTS

The HVAC sector projects a growth rate significantly higher than other industrial sectors (7.6% by 2020), pointing out that the industry will reach a total of $ 120 billion dollars of profits, being one of the industrial sectors with the greatest growth potential and global participation [34], [36]. This growth is due to the increasement of construction activities as the main driver of the sector, along with the establishment of new building guidelines, including smart systems to control and regulate air conditioning and temperature in order to place new edifications at the forefront of world-class trends, which are mostly related to the efficiency and sustainability of systems [35].

Globally, the HVAC sector has been influenced by considerable technological and socioeconomic trends such as population growth, the use and massification of intelligent temperature control devices, efficient and aligned to energy saving, the fast adoption of VRF (Variable Refrigerant Flow) technology in air conditioning systems, the demand for integrated systems, and the introduction of air purification technologies due to the demand of users in geographic contexts with high levels of Pollution [41]. Figure 2 shows the visualization for the global context, i.e., all the information collected.


Figure 2. Visualization for Global Context. Results of the analysis powered by: http://worditout.com/

In the global context, the traditional business models components associated with the HVAC sector are those related to the manufacture and commercialization of air conditioning, refrigeration, ventilation and heating systems, as well as design, installation, assembly, maintenance, repair and manufacturing, which represent a greater relevance in the analysis developed. The main market for these services is the commercial sector (shopping malls, warehouses, shops, etc.), followed by systems for industrial installations. Some companies also emphasize the realization of research and development activities, especially the big producers of equipment to reinforce their business models as United Technologies Corporation (UTC), Carrier Corp., Bryant, Totaline, Payne, York, Metasys, Thermo-King, Trane, Daikin, Lennox-International, Inc., Mitsubishi Electric, Mitsubishi Heavy VRF, Fujitsu, Hitachi, Sanyo / Panasonic and Toshiba, LG Electronics, Samsung, Gree, Midea, and Haier, among others.

- *Initial proposal of the business model for the supply, commercialization and sale of weatherization services in buildings in the tertiary sector through the use of clean and efficient technologies*

An initial version of the business model was built using the methodology proposed by [13], which provides as a starting point a need for the customer segment associated with the costs of maintenance, repair, acquisition and installation of air conditioning equipment for constructions of the tertiary sector. Nevertheless, the initial validation through the map of empathy between the customer segment and the value proposition allowed us to reconsider this model towards the actual client pain point, which is mainly associated with the energy consumption costs of HVAC equipment and the need for legislative aspects on the use of clean and efficient technologies.

This study aims for the determination of a business model that allows a company to generate competitiveness within the provision of air conditioning services, specifically the offer of an integrated weatherization service in buildings integrating the system variables corresponding to the Tertiary sector in the Colombian Caribbean Region. Table I shows the proposed business model canvas.

TABLE I
Canvas of the proposed business model

<table>
<tr>
<td rowspan="2">Key Partners<br><br>Manufacturers of air conditioning systems<br><br>Electric Service Providers<br><br>Human Resource Outsourcing services</td>
<td>Key Activities<br><br>Air conditioning system consulting<br><br>Installation<br><br>Maintenance<br><br>Reparation<br><br>Technical service<br><br>Commercialization</td>
<td rowspan="2">Value Propositions<br><br>Climatic comfort and total tranquility with no consumption concerns and remaining aspects related to the purchase, installation, maintenance, repair and related services of client´s air conditioning system.</td>
<td>Customer Relationships<br><br>Exclusive personal assistance</td>
<td rowspan="2">Customer Segments<br><br>Companies of the tertiary sector (Hotels, schools, hospitals, among others.)</td>
</tr>
<tr>
<td>Key Resources<br><br>Machinery<br>Equipment<br>accessories<br>Human talent<br>Physical infrastructure</td>
<td>Channels<br><br>Commercial team<br>Internet<br>Customer service offices</td>
</tr>
<tr>
<td colspan="3">Cost Structure<br><br>Human Talent (Full-time, part-time, outworkers) Public services, Purchase of equipment, machinery and accessories.</td>
<td colspan="2">Revenue Streams<br><br>Payment for the expenditure of energy due to weatherization services and a commission percentage on the real saving in the consumption of the building</td>
</tr>
</table>

The proposed business model focuses on the segment of clients related to companies in the tertiary sector that are interested in reducing the costs associated with the energy consumption of their HVAC systems, part of this level of consumption can be explained by the very nature of the life cycle of the technologies they currently dispose (manufacturing, construction, operation, maintenance and replacement).

The main proposed objective is to achieve in the customer the unconcern for the aspects related to the selection and purchase of refrigeration equipment, facilities that must have a maintenance process and in some cases incur in repairing, a crucial aspect that has become a headache for customers. Elements which do not add value to the main activity of the company.

Therefore this value proposition aims to provide a comprehensive service that ranges from the selection of the best alternative according to the requirements of the customer, including the purchase, installation, maintenance, repair and technical service, which are completely in charge of the company and not the customer, which only makes a monthly payment for the cost of the service and a commission percentage of the actual savings in the consumption of HVAC equipment.

It is considered that the proposed business model set forth innovations since it suggests an integral system of control and monitoring for the administration of the energy saving in HVAC systems in the buildings, being this a product that is not currently offered in the region, or even in the country.

Another fundamental aspect of complying with the stated value proposition is the technological aspect, initially; it has been identified through studies related to the macro project to the VRF (Variable Refrigerant Flow) technology as the optimal for the service proposed by its potential of energy saving against other technologies. Furthermore, the technological surveillance report carried out within the framework of the macro project that gives rise to this study indicates that the implementation of air conditioning technology in VRF type buildings has been exponentially growing worldwide and that this type of Technology will experience an annual growth rate of 11.4% between 2016 and 2022. The same report points out to after a patent and scientometric analysis, the evolution of VRF technology and its potential benefits within clean and efficient technologies for the sector [42].

The business model initially proposed in this paper have been addressed to geographical areas with similar characteristics to the Colombian Caribbean region, but this does not limit the possibility of carrying out studies in geographic areas with other characteristics in order to validate Its viability. Moreover, the intention is to consolidate the sector's offer in terms of the services offered by the vast diversity of SMEs and independent technicians who provide installation, repair and maintenance services for air conditioning systems and equipment, thereby increasing the competitiveness of the tertiary sector of the Caribbean region.

## IV. CONCLUSION

Under the research methodology used to collect information and data about the companies, it wasn´t possible to identify a punctual service offering such as the one proposed in the framework of the established business model canvas. It was found that globally, companies offered these services independently and that there are different approaches in the emphasis on the type of the provided services in each studied geographical area.

A technological surveillance was carried out examining patents and scientific publications, considering search terms such as Optimization, Control, Simulation, Modeling, variable refrigerant flow, air conditioning systems, comfort temperature, air volume variations, VRF, air conditioning, Energy Efficiency in Buildings, Energy Plus, Expansion Valve, Downloads, and Measurements. Those terms were useful to identify the VRF technology with the most adjusted suitability to the needs identified for buildings of the tertiary sector in the Caribbean region due to its high efficiency, potential energy saving, adaptability to specific temperature requirements in different areas of the building and exceptional flexibility of installation, which allows easy maintenance, which translates into costs reduction.

The comparison of profiles of value propositions at the global level, allows to set a proposal aimed to achieve a level of desired climatic comfort and the tranquility of the client, aspect that constitutes an innovation in the business model, integrating a set of services under a single offer, favoring the provision itself and generating benefits to the customer, as well as the monetarization model of the offer, which initially contemplates a charge for consumption of weatherization services and a commission percentage over the actual amount of savings achieved in the energy consumption of HVAC equipment.

This study was carried out with a limited number of companies in each region analyzed according to the methodology presented above. It is considered that one aspect to emphasize is that companies of different sizes were examined, which enriches the analysis since there are considered value proposals of SMEs and large companies. For future studies, it is proposed the development of a study of HVAC companies in the Colombian context and each of its regions.

Finally, considering the limitations of the study, it is proposed a complete revision and validation of the model once the macro project has been completed in other geographic contexts and a prolongation of the group of companies observed at the global level in order to enrich the contribution of the study.

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