ABSTRACT

Over the years, the urban trade has experienced a continuous transformation. The product, the traditional source of competitive value, has been losing protagonism, giving ground to comfort, accessibility and the offer of satisfactory shopping “experiences”.

Architecture, as a stage where urban retail takes place also changes, turning from a mere container into a marketing tool for increasing sales. Attractive, comfortable and accessible spaces are created to capture the attention of the buyer. At the same time, due to the increasing protagonism of distribution channels’ logistics, it has been linking more support architecture in the previous processes to the sale moment. This new physical structure implies a series of investments: space, matter, energy, resources, technology. And the whole commercial architecture (the one that one sees and the one that one doesn’t see) since today has been valued only by its effectiveness (increase of sales). Nevertheless, it hasn’t been questioned its efficiency, considering the impact that every kind of sale exerts on the urban environment.

In the model of current cities coexist different forms of commerce, with different associated architectures: stores that use existing resources (street market), others that require completely new elements (commercial developments), or cases where architecture apparently “disappears” (Internet). All the architectural models cohabit and generate good results. But, which is the best positioned considering its environmental impact?

The objective of the research is to quantify the impact of architecture linked to commerce in present condition of the environment and the city functioning. By means of the classification of the existing models and the quantitative assessment of three basic parameters (energy, matter, complexity) considering functional criteria in each case (the product); suggestions inside the built environment are formulated, to achieve an urban commerce more sustainable.

This research, in development at present, is inscribed in the PhD program “Research in Building Environment and Energy in Architecture” at Universitat Politècnica de Catalunya.

1. THE ARCHITECTURE OF COMMERCIAL ACTIVITY

1.1 Activity Evolution and commercial space.

The commercial activity is a simple and delimited process: it is obtained something in exchange of something, to the satisfaction of basic needs. But, the change of the habits of purchase have done that it becomes also in an entertainment activity (I have to buy- I want to go shopping). This activity is contained in a spatial structure, whose basic intention is the satisfaction of functional demands in the sale of the different products: to store, to preserve, to show. Nowadays, a store must answer to
different external factors linked to the process of the sale: tendencies, environmental conditions, technological advances... All of them with changeable nature, then the trade space has to be in continuous reinvention, suffering a continuous coupling to those circumstances in order to support day by day its validity. Because "yet even though shopping has expanded to the point of ubiquity, even though it is such an inherent part of daily life, and even though it overwhelms other activities in number and scale, it is also the most unestable and short-lived, the most vulnerable to the threat of decline and obsolescence" [1]. In commercial activity, the innovation and the added value are fundamental for the captation of more clients and therefore the insurance of a certain number of sales.

This continuous renovation is materialized through the progressive incorporation of physic and technological means that favor the process of commercial exchange in different ways: environmental control elements allow the sales in spite of the changes of climate (rain, sun, natural light, night), containers that guarantee the availability of wide stocks of product preserved suitably, inventory control and payment and security systems, new and attractive ways of presenting the products to the buyer, etc (fig. 1).

Actually, the trade space has become in a way of communication of the product information, from the most basic (price, quality, age of the clients who is directed..), up to the philosophy of a brand (the case of the flagshipstores) (fig 2). The style of a store has become in a marketing tool, like the conventional strategies of tv and radio spots or press announcements [2]. In the same way, with the commercial space "shop experiences" are constructed, directly linked with the new ludic sense of shopping activity: comfort, innovation, created atmospheres to trasmit specific messages.

1.2. The architectural forms of trade.

The consideration of these new factors give rise to the appearance of different interpretations of the same problem: the sale. In the models of current cities coexist different sceneries of trade, with uneven levels of architecture associated to the interchange process. And even all of them follow the same purpose (to sell), the investment of resources in the new forms of commerce and their spatial structures respond to unconnected parameters, making unclear the identification of an evolution tendency: In some cases the architecture “disappears” as the sales scenario, being considered as a temporary/space limitation to an accessibility more fluid, constant
and generalized of clients, like on the internet, tvshops and catalog sales… And at
the same time huge commercial complex are built with an important physical
structure and complementary services, totally unconnected of the urban structure
and conditioned to the exclusively access through private transportation… Or shops
that take totally advantage of the urban preexistences (streets, parks, squares…) like
the street markets.

The tipologies inventory would be bigger, if is not observed only one geographic
scenario. Around the world exist different physical forms of retail temporary parallel,
but due to different economical or social factors (not functionals), their existence is
feasible in some places but impossible in others (fig 3). For example, the sell of
products exposed on a blanket lying on the floor is a common practice in african,
asiatic or south american countries, but in most of the european countries this practice
is directly linked with precariousness or illegality.

These new tipologies of retail spaces are the “visible” link (the one with the client has
direct contact) of a complete chain of architectural units associated to the retail
process through the distribution channel, the way the products are moved from the
production point to the retail point where the consumer buys them [3].

In the past, the architectural structure of the distribution channel was so limited,
containing the whole process – production, storage, sale – in only one building,
without any input of transportation (for example, the typical bakery where storage of
raw materials, baking and sell occurred in the same building). Today, due to
globalization, the high costs of soil, and the effort for a constant reinstatement of
goods and the increasing importance of the “just in time” concept, the previous
stages to the sale tend to separate physically from the retail point, managing to be
exiled from the city to be contained in enormous buildings that allow the optimization
of resources by means of the control of big stocks that will be distributed to multiple
points of sale. Then appear industrial areas in the periphery of the cities, with logistic
and storage centers, huge infrastructures that allow the captation and management
of products from different places before being distributed.

The appeareance of these buildings, the high cost of soil and the high occupation o
commercial districts in the city, induce to the expulsion of the storage from the trade
space, where is rising the tendency of use and implementation of logistical systems
for daily reinstatement of goods reducing the space needed for storage, maximizing
the space of sale, but increasing at the same time the transportation of goods (fig 4).

All this new physical infrastructure implies a serie of investments (space, matter,
energy, means, technology). And the whole commercial architecture (the one that
one sees and the one that one doesn’t sees) since today has been valued only by its
effectiveness (increase of sales). Nevertheless, it hasn’t been questioned its
efficiency, considering the impact that every kind of sale exerts on the urban
environment. All the models coexist and their validity confirms to us that they
generate good results. But, which is the best positioned having as a reference the impact that they generate in the city?

1.3. The architectonic impact of retail.

The presence of different architectural forms of retail generates a series of impacts on the city, both in its physical configuration and its functioning:

1.3.1 Territory occupation and mobility affectation.

Due to the trend of an increase in number and measure of the commercial establishments, it has been implemented alternatives to the proximity commerce, like big surfaces in peripheral zones of the city, which are tied to new road and urban development planings, up to the marketing of public buildings (stations, libraries, hospitals…).

The location of a store implies, apart from the surface dedicated to the sale and all the attached services needed for its proper functioning, particular characteristics of accessibility (parking lots, proximity to public transportation), both for clients and the traffic of goods. Then, besides the impact that represents its physical presence, it is important to consider the collateral effects of its location (table 1).

1.3.2 Energy consumption

According to the different studies of Agencia de Energía de Barcelona (case of study in this research)[4], the tertiary sector consumes 37% of the whole annual energy (table 2). But, it is necessary to bear in mind that an important part of the commercial processes is constituted by the movement of goods, then it's necessary to consider in addition the portion corresponding to the transportation, a 9.9% of the whole energy.

![Fig. 4. Different distribution channels of urban commerce. Images from www.gettyimages.com](image)
This 30% of energy consumed, correspond basically to demands of heating, cooling and electricity (table 3).

![Diagram](image1.png)


The high indexes of consumption are the consequence of an unlimited use of means, which are translated in pollution, the depletion of resources and the modification of the functioning of the cities. For example, according where is bought (shop of neighborhood, supermarket, hypermarket, internet), in the sale of the same carton of milk, unlike quantities of resources are invested. Then it is necessary take measurements focused on the improvement of the conditions of consumption of the different kinds of stores, supporting the conditions of comfort and accessibility.

![Diagram](image2.png)


Inside the different architectures of retail, there is identified a trend of progressive increase of utilization of resources (matter, energy, information). Even the simplest models, a street market for example, have an important load of architecture linked to the process of the sale, if we bear in mind the long channel of distribution for the low cost goods have to pass before being offered in the market (warehouses of storage in the place of origin - port of exit - port of arrival - warehouse of wholesale in destination - retail storage - street market). Therefore, for evaluating the investment of resources of a point of sale, there must be contemplated the “architectural rucksacks” that it could have linked.

All these factors suggest the need to establish some parameters to enable the identification a point of efficiency in the architecture of a commercial typology, understood as the balance between the invested means and the obtained benefits; in order to raise recommendations in the constructed environment, for the achievement of a more sustainable urban trade.

2. EVALUATION OF RETAIL ARCHITECTURAL PROFILES: A METHODOLOGY.

To identify this “point of efficiency”, it is necessary to define an applicable methodology in the analysis of cases, providing means for the quantification of the architecture invested in the process of sale, and its assessment depending on the obtained results. The methodology proposed in this research is composed by four principal phases:

- Delimitation of a specific area of study.
- Identification of architectonical parameters of evaluation.
- Fieldwork (measurements)
- Comparison of results and final conclusions
2.1 Delimitation of a specific area of study.

In order to establish a specific area of study for the quantification process, it is necessary to identify three basic elements:

a. Physical composition: identification of characteristics and basic components in the trade space and the distribution channels, in order to establish the architectural elements and their function.

b. Identification of the architectural profiles in a delimited geographical field: the viability of an specific type of store depends on the social, environmental and economic characteristics of the place, then it’s difficult to compare two tipologies placed in different contexts. For the development of this research, the commercial tipologies of Barcelona will be identified and studied.

c. The Product: the characteristics of the product delimit the necessary means for its marketing, then it’s necessary to identify the tipologies of products and their requirements.

2.1.1 Physical composition

The physical structure of a store is composed by sections, organized according to the basic activities of the commercial interchange: to handle the product (to store, to preserve) and to exchange it (to exhibit, to sell). The configuration of these sections will change depending on the type of product that is commercialized. (fig 5).

![Physical composition diagram](image)

Each tipology identified, will be endowed total or partially with these elements, according to the determinants exposed at the beginning and the different “systems of sale” [6], that define the spatial configuration of the sale surface (fig 6):

- Service: sale across counter
- Preselection: allows to evaluate the product, then facilitated by the salesperson.
- Free election: the client can choose the product, and has the option to decide if wants to be advised or not.
- Self service.
2.1.2 Architectonic profiles of urban commerce. The case of Barcelona

In order to unify the socioeconomic environment of the urban commerce profiles case of study (and then to facilitate the architectural and functional evaluation), it is necessary to delimit the search in a geographical concrete area. Barcelona is a city characterized by a wide, rich and plural commercial offer, regulated by the decree 378/2006 (develop of the law 18/2005 of commercial equipments), which contains the commercial tipologies that exist in the Catalan community [5]. In this decree, the commercial tipologies are classified bearing four basic criteria: surface, form of sale, variety of the offer and the relation with other stores. Nevertheless, for the purpose of this research, it is necessary to incorporate two more parameters of classification:

- How it links and interacts with the urban structure, and
- The characteristics of its physical structure.

Thus, all the tipologies identified in the city could be included and differentiate (fig.7).

It is necessary to emphasize the validity for the contemporary buyer of so unlike tipologies, like the mall “La Roca village” conditioned to the utilization of the private transport and 38 km of distance from the city, with the great variety of itinerant establishments (street markets) or season stores (sale of chestnuts, ice creams or gunpowder) that are installed in the public spaces taking advantage of the preexistences of the city. Today, all of them report good results.

Fig. 7. Classification of architeconic profiles of commerce in Barcelona.
2.1.3 The product

There is two types of products: goods and services. Goods are material products, that produce the satisfaction of a defined and delimited desire or need, and will be the object of the present study. To define the basic architectural requirements for the sell of a product, it is necessary to analyze every product as a particular case (the means required to sell an expensive ring are not the same to sell a piece of bread). To consider all the products existing in the market is pretentious, then two basic parameters of classification have been identified, in order to get into general groups, so having studied three concrete cases a methodology applicable to the rest could be established:

- Price: is the expression of value assigned to a product in monetary terms.
- Frequency of purchase: repetitions de acquisition of a product in a certain period of time.

The classification of goods and services COICOP (Classification of Individual Consumption According to Purpose) used by the National Institute of Statistics to realize the EFP (Encuesta de Presupuestos Familiares 2006) [7], takes these two parameters as a reference (fig.8):

<table>
<thead>
<tr>
<th>TWICE-WEEKLY</th>
<th>MONTHLY</th>
<th>QUATERLY</th>
<th>ANNUAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food: bakery, grocery, meat, produce, frozen products.</td>
<td>Clothes and shoes</td>
<td>Mobility and decoration: blankets pillows, almohadas, cutery…</td>
<td>Mobiliary: big furniture</td>
</tr>
<tr>
<td>Mobiliary accessories</td>
<td>- Small appliances</td>
<td>- School books</td>
<td>- Big appliances</td>
</tr>
<tr>
<td>Cleaning products</td>
<td>- Sports articles</td>
<td></td>
<td>- Cars</td>
</tr>
<tr>
<td>Pharmacy, perfumery</td>
<td></td>
<td></td>
<td>- Art and musical e instruments</td>
</tr>
<tr>
<td>Hobbies</td>
<td></td>
<td></td>
<td>- Sport articles (gym)</td>
</tr>
<tr>
<td>Newspaper, magazines.</td>
<td></td>
<td></td>
<td>ANNUAL +</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Art - Jewelry - Real estate</td>
</tr>
</tbody>
</table>

Fig. 8. Classification of goods used in EFP according to COICOP.

2.2 Identification of Architectonical Parameters of Evaluation.

From the combination of these elements is possible to delimit an area of study, common for all the cases that will be object of the assessment. The architecture linked in their commercial exchange process would be measured, qualitatively and quantitatively in three basic units (fig.9):

<table>
<thead>
<tr>
<th>City of Barcelona</th>
<th>Retail architectural profiles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product Basic characteristics (identification of spatial needs)</td>
<td>Analysis of architectural profiles for the sale of a product and identification of previous stages in the distribution channel.</td>
</tr>
<tr>
<td>Investments Quantification of resources required and benefits</td>
<td>Architectonic intensity</td>
</tr>
<tr>
<td>Space Kg architecture</td>
<td>Energy Energetic Intensity</td>
</tr>
<tr>
<td>Information complexity</td>
<td>Frequency of sale</td>
</tr>
<tr>
<td>Architectonic Intensity (energy, matter, complexity)</td>
<td>a specific product</td>
</tr>
<tr>
<td>Frequency of sale</td>
<td>Architectonic Efficiency</td>
</tr>
</tbody>
</table>

Fig. 9. Evaluation of retail architectural profiles scheme.

2.2.1 Evaluation concepts

The development of the assessment will be based on the following concepts (fig.10):

<table>
<thead>
<tr>
<th>What is measured?</th>
<th>Frequency of sale</th>
</tr>
</thead>
<tbody>
<tr>
<td>a specific product</td>
<td>Architectonic Efficiency</td>
</tr>
</tbody>
</table>

Fig. 10. Assessment process scheme.
2.2.1.1 Architectonic Efficiency

Is the relation between the obtained results (in this case, units of product sold) and the used resources. The basic goal is to obtain the programmed aims with the minimum of available means and time, obtaining its optimization and its rational use.

Then, Architectonic Efficiency = \frac{\text{results}}{\text{resources}} = \frac{\text{frequency of sale}}{\text{Architectonic Intensity}}

2.2.1.2 Frequency of sale

Is the number of occurrences of an event, considering a temporary interval. In this case, the event are the units of product sold, and the temporary unit to consider depends on the type of product, according to COICOP classification.

For example: Bread = units of product sold/day
Cars = units of product sold/year

2.2.1.3 Intensity

Is the grade of force with a natural agent, a physical magnitude or an expression is demonstrated. The architectonic intensity is measured through the quantification of Three units: Energy, Matter and Complexity.

The architectonical impact of a profile has to be measured considering the development of the activity contained, then the time has an important place in the assessment. Time enables to quantify the architecture invested per units of product sold, considering the frequency of sale and the durability of the architectural elements in retail, understood not only as a technical factor, but also as a design parameter to avoid the functional obsolescence. [8]. Already in the paper “Space use optimisation and sustainability - environmental assessment of space use concepts” [9], Andy van den Dobbelsteen and Sebastiaan de Wilde establish that the use of space for a certain function may be considered in different dimensions: 2D (one layer of floor), 3D (picture of all two dimensional layers related to a referent layer) and 4D: time.

a. Energy: It has to be consider only the energy used in the trade space during the sale: lighting, cooling, heating, security, settings, management systems... The temporary unit, will be the same used for the frequency of sale.

Then, Energy = \frac{\text{Kw consumed}}{\text{temporary unit}} = \frac{\text{Kw consumed}}{\text{units of product sold}}

b. Matter: is the amount of architecture quantified in m2 and kg.

- Squared meters (PSU): the surface used in a commercial tipology to sell an specific product. Considering that every product needs a suitable quantity of square meters for its marketing (functionally, more m2 are needed to sell a car than a bread) is possible to establish a PSU (Product Spatial Unit) and detect in which cases is invested more space than the functionally needed. Only are considered the m2 of sales space, the area where products are exposed and are located the services for the buyer (payment, fitting rooms, etc).
- Kilograms (KG): The kilograms architecture are considered in two categories, according to their useful life: the container has longer useful life than the space of sale, composed by many elements in continuous change (due to marketing strategies, scenographic elements in the space of sale are changed continuously, without considering their useful life):

Container (premises): kilograms of envolvent elements like the structure, roof, façades, dividing walls between premises.

Space of sale: false roof, pavement, interior partitions, furniture, decoration.

The architecture linked to the distribution channel (architectural rucksacks) in every case studied, will be consider in kg, adding the kg of architecture linked per unit of product.

Then, \( KG = \frac{Kg_{\text{architecture}} \times \text{SUP}}{\text{Squared meter \ useful life}^*} = \text{total KG} = \frac{KG}{\text{temporary unit}} = \frac{KG}{\text{product unit}} \)

*(durability in days, months, years, depending frequency of the product)

c. Complexity: the geometrical and technical complexity of the sales space (amount of installations and systems used to the conditioning of the space). The quantification model of this unit is actually in development.

2.3 Fieldwork (measurements)

Once the methodology is defined, will be developed a fieldwork process, composed by the following phases:

a. Selection of three specific products with different frequencies of sale (bread, clothes and cars will be studied).

b. Identification of architectural profiles in which the selected products are commercialized.

c. Fieldwork: development of surveys in different cases selected for the capture of information: sales frequency, energetic consumption, architectonical characteristics.

d. Elaboration of calculations and comparison of results.

3. CONCLUSIONS

- A product could be sold in different architectonic structures. These structures have to respond to the functional necessities for the sell of the product, and to another complementary factors, like the buyer’s persuasion through spatial scenographies and comfort, the necessity to make the difference in order to attract more clients, and the continuous implementation of technological advances that facilitate the development of the activity.

- Along the history is identified a clear trend to sell the different products investing the just means, the minimum required to make possible the commercial exchange in agreement to the particular characteristics of every product: we wouldn’t sell a very expensive jewel in a street market, or we wouldn’t sell an obsolete computer in a luxury store. Nevertheless, nowadays this trend is not completely legible, due to the progressive incorporation of means (physical technological, energetic) and the trend to the complexity
of the space of sale. For example, according to where is bought, the sale of
the same carton of milk implies an unlike investment of resources. (shop of
neighborhood, supermarket, hypermarket, internet).

- The increase of resources used to the sale of a product, is perceived in major
measure in the developed countries. This increase not necessarily supposes a
waste of resources and consequently an imbalance between the invested
means and the obtained benefits. It answers to the satisfaction of a serie of
“intangible” needs, and the premise of make the difference as a marketing
strategy, which represents a increase of the sales. Then, having evaluated the
different architectural tipologies used for the sale of one product in a
socioeconomic certain environment, it is possible to identify a point of
efficiency.

- All the forms of trade bring linked an architectural structure. Even the forms
of sale in which the space of sale “disappears”, exist a serie of “architectural
rucksacks”, spatial structures containing the different phases needed in the
process of sale until the product comes to the buyer. And all the forms of
trade, in major or minor measure, influence in the functioning and the
configuration of the city.

- Nowadays, thanks to the widespread awareness about the environment
condition and the urgency of take a more sustainable life, there has been
evaluated the architectural impact of housing, offices, schools, or even the
urbanism of the cities. Nevertheless, the commercial activity ant its spatial
structure haven’t been questioned, in spite of their big influence in the situation
of the environment: it is a daily and widespread activity.

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