Heuristic for the localization of new shops based on business and social criteria

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Abstract:

The last financial crisis and the globalisation of the retail industry resulted to a massive close of local shops which leads to an important proportion of unoccupied space in the city. The desertification of the urban economic environment is not only a business issue discouraging the potential investments but also a social problem of security or quality of urban life. Different solutions exist: from the top-down and historical approach based on subsidies to the bottom-up and its different options: the urban entrepreneurship or a more temporary form called successively 'pop-up', 'second-hand' or 'urban pioneers'. Nevertheless, all these solutions have in common that the location is an important criteria to achieve a market-led regeneration of the city. Our paper consists on developing a heuristic that prioritises the opening of new shops amongst the void locations based on a business and social criteria. Our results corroborate the convergence of the social, business and technology sciences. They provide a method and a tool for the city managers to monitor and manage the opening of new shops. Included in the policy of the smart city, they allow to decrease the risks of uniformity, 'mono-business activity' and gentrification of the neighbourhood.

1. Introduction

Starting in 1970s, the consolidation of the retail industry has resulted to a vast decline of the local commerce of proximity and the apparition of vacant plots. The globalisation after 1990's has accelerated the concentration of industries through merges and acquisitions and let a lot of small and local shops to close down in different European cities due to financial pressure (OECD, 2012). In 2006, 14,4% of Berlin's spaces were classified as 'vacant areas' (Colomb, 2012). They could be abandoned industrial sites or disused buildings. More recently, the impact of the 2008 global financial and economic crisis around the world are generated sharp cuts in public investment, affected the growth of the cities and drastically impacted these vacant zones by the abrupt slowdown or complete halt of construction activity. Buildings, residential precincts half-built up where construction is unlikely to resume in the close future, are a common sight in many countries such as Island, Portugal, Greece or Spain (Colomb, 2012)

These different trends have consequently lead to a desertification of the urban economic environment which in its turn, discourages investments and increases the stigmatisation of the neighbourhoods (Carley, 2000). In parallel, cities have been receiving more and more residents asking for more and more services of quality. The theoretical concept of smart city is originated to give an answer to this challenge. Actually, it is a consolidation from various brands such as 'intelligent city', 'knowledge city' (Caragliu et al., 2009), 'digital city' (Komninos et al., 2012), and 'ubiquitous city' (Vespignani, 2009) where all share that technology is a key driving force in delivering innovative services. While our historical social insurance schemes and tax-financed services are getting more and more monetarily constrained and become less and less able to respond effectively to rising societal needs (Hollands, 2008), the social impact of the retail distress is evidenced by a growing array of urban security problems (Carley et al., 2001). To face this issue, managers of the smart cities have developed business-led urban regeneration plans as an alternative solution to the usual subsidy-based one. Richter et al., (2015) observe this strategy represents lots of opportunities for city-minded people wanting to engage in commercial activities but thinking also on their social responsibility to improve the urban living conditions (Kraus et al., 2015).

The recent works of (Grimaldi & Fernandez, 2017; Harris, 2015; Ziehl & Oßwald, 2015) show different options exist to develop market-led initiatives that may cover business and social objectives. They have in common the empowerment of the citizens (bottom-up approach) and contrast with the top-down system of subsidies and grants (Smith & Sparks, 2000). The localization of the shop in the city map takes a paramount aspect (Diao et al., 2006). It is indeed a strategic external variable of competitive advantage and business sustainability since directly linked to customers' visits frequency (Kolympiris et al.; Minai et al., 2011). In our paper, we argue moreover that the adequate position of a shop in the city map is also a condition to contribute to a social objective. Consequently, we determine a heuristic to localize new urban venturing opportunities that can cover business and social criteria.

Our methodology considers the smart city as a complex network where streets are links and street intersections are nodes (Newman, 2010). Hillier (1996) previously applied the networks theory to the city and showed that the position and the freedom degree of a line may either increase or decrease the attractiveness and the sustainability of the local businesses domiciled in the street. Our approach consists to leverage his conclusions. Shops can cover different social purposes which include artistic, cultural, leisure, entertainment, sports or gardening (SenStadt, 2007). For our paper, we choose the educational aspect echoing the recent works of Grimaldi & Fernandez (2017) concerning an European large smart city initiative called 'The Road to School'. The authors argue indeed that the local shop may have a social impact increasing the autonomy and mobility of the children if it provides them aid in case of danger during their path to school. Our results corroborate the convergence of the social, business and technology sciences (Spohrer & Maglio, 2008). They provide a methodology for the city managers to measure, monitor and actively manage the opening of new shops. Included in the policy of the smart city, they allow to decrease the risks of uniformity, 'mono-business activity' of the shops and the gentrification of the neighbourhood.

2. Literature review on urban regeneration

During 1970-1990, the retail sector has been concentrated to fewer and larger big chains of stores which sell food, electrical goods, clothes, shoes, toys and other products. These latter may include also a baker, a fishmonger or other in-store shops. Later, the internet growing adoption has accelerated this consolidation and has made that independent and small retailers suffer a relentless decrease with thousands of shops closing every year (Ellis-chadwick et al., 2002). Consequently, the lack of local shoppers discourages investment and participates again on the decline of these urban areas and its stigmatisation, moving away the spending power of the residents to fund the necessary social services. Today, many empty sites punctuate the landscape of many regional and national capitals (Carley et al., 2001).

Diao et al., (2006) add the decline of the local retailing in the urban core brings not only serious economic and unemployment problems but also social and environmental ones. As small shops close, more people have to, or want to, drive to large stores to meet their daily needs. Poor households have less opportunity to go to alternative facilities. This can contribute to ill health associated with poor diet. Derelict shopping areas visible to passing traffic contribute to the stigma faced by such neighbourhoods, adding to the impression of 'dead frontage' (Carley, 2000). A feeling of danger emerges and more parents decide to drive their children to school producing a negative impact on the development of the autonomy and experiential learning of the young generation (Trost, 2005). This extensive use of the car increases the problems of congestion and urban contamination also. On the contrary, when local shops open, it is the urban life that is improved. The lights of the store provide more 'peace' (security) in the streets and the commercial activities represent a new link between citizens. It is therefore part of the social agenda for many

cities that these small existing shops must keep opened and running and; besides to find solutions to fill the vacant locations and reduce the urban voids. These cities are called smart and represent a conceptual urban development model on the basis of the utilization of human, collective, and technologies (Angelidou, 2014) even it is important to recall that a clear and common definition does not really exist (Angelidou, 2015). Different solutions of urban regeneration already exist and have been described. The more conventional and traditional ones are top-down requiring public or state resources (Smith & Sparks, 2000). They are indeed based on subsidies and grants to help the store to better survive or perform against the competition. They are usually oriented to fit out the internal shop furniture with more modern equipment or improving the street-front. They can take also the form of loan program giving advantageous low rates of interest or also training sessions organized by retail consultant experts (Stevens & Amber, 2010).

Nevertheless, alternative urban policies have been recently tested to occupy these dead zones. They usually cover up for the 'absence of public investment' (Colomb, 2012) and are all in common to move from a top-down to a bottom-up approach giving a more important role to the citizen. Richter et al. (2015) observing the slight transformation of the urban governance from a public managerial to an entrepreneurial focus stress the importance of the emerging technologies e.g. Big Data, Social Media and Internet of Things (IoT) as drivers of this change. They add, this business-led urban planning represents lots of opportunities for citizens wanting to engage in commercial activities and appoint a more important social role to the private sector participating to the creation of solutions to improve the living conditions in the city. Muñoz & Cohen (2017) introduce for the first time the similar concept of urban entrepreneurship. They define it as an actor that seeks for well-being in urban contexts, moving from the traditional logic of 'problem to solution' to one of 'opportunity to venturing' and challenging the traditional market structure and institutions.

On the one hand, these opportunities are purely market-led with the objective to fill the voids by permanent and financial sustainable shops. The theoretical and methodological approach to business-led urban regeneration starts with the work of Michael Porter (Porter, 1995) and his close relationship with the initiative for the Competitive Inner City. In his work, Porter states that urban areas have four strategic advantages: location, untapped local market demand, clustering and human resources. Wiener et al. (2008) add the development of business-led city planning as a discipline has been deeply informed by the idea that services and shops of different natures should be consistently located in places of a corresponding level of 'importance' or 'prominence'. In other words, some locations have more potential than others because they tend to have higher densities of business development (Kolympiris et al., 2014). Minai et al. (2011) observe the location is one factor that entrepreneurs need to consider during the process of opportunity discovery (Littunen & Niittykangas, 2010).

Recently, the term of 'pop-up' places or events have increasingly influenced the policy of the cities in the north of Europe (Harris, 2015). They are market-led flexible solutions to occupy voids by private organizations re-valorising places and constructing activities easy to remove and reallocate in the future if necessary. This flexibility is a response in 'times of economic uncertainty' providing reduced economic risk and given shorter return on investments for the projects (Bishop & Williams, 2013; Deslandes, 2013). These 'pop-up' demonstrate a different use of space-time, working not only in the physical but also on the conceptual 'margins' of the city (Tonkiss, 2013) giving the sensation of entering an area somehow separated from the rest of the world (Griffiths, 2013) incorporating elements of fictions, fantasy, romanticism, ludic

imaginaries which differentiate them from a standard market-led approach (Smith & Sparks, 2000).

But, these opportunities to fill the voids can be also overtly social-led. Their objective are artistic and cultural as Colomb (2012) explains it in the example of Berlin post fall of the wall and reunification period. They are for 'interim' or 'temporary use' in opposition with conventional market-led development processes (Smith & Sparks, 2000). In this context, temporary spaces are milieu for social and 'creative entrepreneurs' and key for the development of the cultural economy (Suciu et al., 2013). They cover a large set of activities which include artistic, cultural, leisure, entertainment, sports or gardening (SenStadt, 2007) and their initiators are artists, 'culturepreneurs' as recently called by Lange (2007) voluntary workers or political activists. The first beach bar in Berlin opened in 2002 installed with sand, deck chairs and exotic decoration on the waterfront of Berlin's canals (Stevens & Ambler, 2010) or the floating cinema which travels London's waterways to screen films (Pratt & San Juan, 2014) are two emblematic examples.

Temporary uses are often perceived by public authorities as a second-best, a 'second-hand' solution (Ziehl & Oßwald, 2015) in absence of other development options or as a prelude to more profitable venture. Overmeyer (2005) coins for the first time these initiators 'urban pioneers' making an analogy with the military scouts who go on reconnaissance trips to map unknow territories and prepare the ground for the rest of the troop. Other opportunities to fill the voids are oriented for a better education and health of the young generation. Indeed, several studies (McDonald, 2007; Salmon et al., 2005; Van der Ploeg et al., 2008) assess the decreasing rates of walking and cycling between home and school in developed nations. Indeed, mainly due to insecurity or unsafety issues in the roads of the city, parents prefer to drive their children to school and tend consequently to control most of their kids' experiences, depriving them of many opportunities to learn by themselves and decreasing the development of their psychosocial or cognitive skills (Burdette & Whitaker, 2005; Tamis-LeMonda et al., 2004), and social prowess (Ginsburg, 2007). Grimaldi & Fernandez (2017) propose the shops to participate in the education of the young generation playing the role of 'reference/friendly shop' in case of imminent danger or health problem for the children whose parents have authorized them to go alone to school.

Nevertheless, to our best knowledge, literature is scanty to propose a scientific method based on a discursive (non-intuitive) and systematic method (reproductive) to optimize the selection of the vacant shops. Our paper aims at covering this gap developing a heuristic which proposes the opening of new shops using a business and social perspective. Our approach consists on selecting the vacant shops of the city using the location as criteria for business and social objectives.

3. Description of the model

Our methodology uses as a starting point the current situation of the city with its voids and occupied lands. Based on the theory of complex networks, we develop an algorithm which recommends and prioritizes amongst a set of the current vacant shops which are the opportunities to open a new business based on two criteria: the first one is business and linked to the flow of people, the second one is social. Amongst the different potential social contribution of shops that we have been previously described (cultural, artistic, leisure, entertainment, sports, gardening, …), we select for our model the educational purpose, echoing the recent works of Grimaldi & Fernandez (2017) about the 'Road to School' project.

3.1. Business criteria

Our business criteria is based on the localization of the shop which has to be situated in a street that attracts enough clients' traffic to ensure a stable and profitable activity and prevent from bankruptcy. The relationship between the built environment and walkability has been extensively studied in several knowledge fields, from the purely urban planning realm (Durand et al., 2011) to epidemiological and public health studies (Lee & Moudon, 2006; Nagel et al., 2008). For our research, we have chosen the growing field of studies which models the street layout as a network (Freeman, 1977). All networks are made up of a set of nodes connected by links. In our case, nodes correspond to intersections between streets. Links are streets joining all nodes or cul-de-sac. Modelling the street layout and the built environment as a network allows us to calculate several measures of network accessibility and flow potential analysis following the seminal works that Shimbel (1953) applied to telecommunications. The figure 1 illustrates the modelling process applied for a small area of the case study chosen as an example.

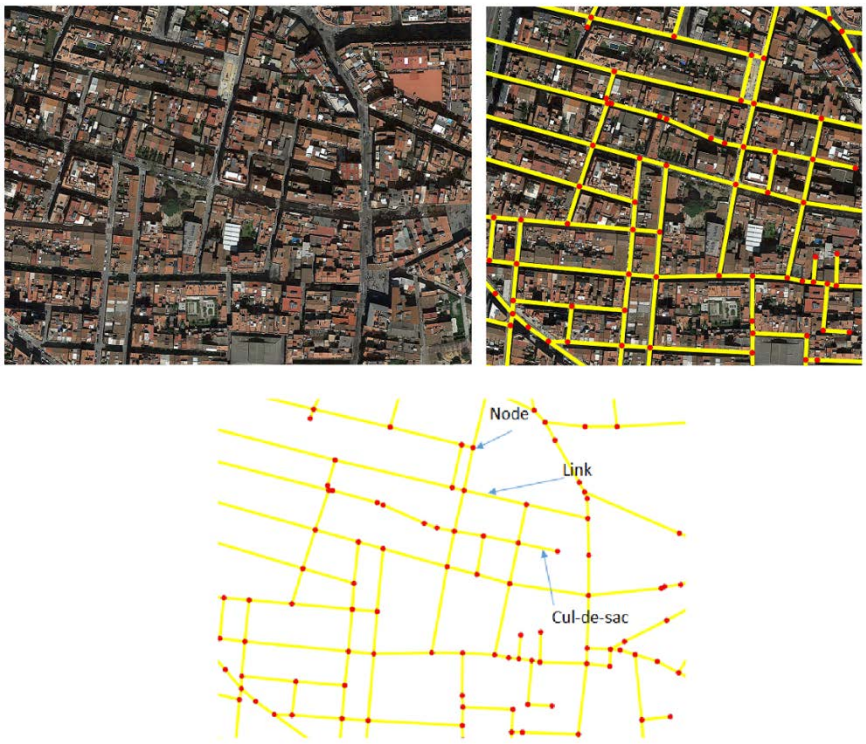

Figure 1: Network modelling process

In complex networks, not all nodes are equally important since they are affected by different connections. The quantity of this connections can be a starting point to determine the rank or centrality of each node of the complex network. However, connectivity does not inform about the importance of the node in the network (Barthelemy, 2004). Closeness and betweenness are forms of spatial network analysis grounded in a long-standing tradition of measuring accessibility and flow potential. Each one measures a form of centrality based on shortest paths through the network; with closeness measuring potential for 'to-movement' while betweenness measuring 'through-movement' (Freeman, 1977). Since our research is intended to analyse the flows of pedestrians and routes to school instead of identifying potential of 'to-movement' (in our case the to-movement is determined by the location of schools), we have focused in betweenness centrality.

Betweenness is a form of spatial network measure to calculate flow potential of people by determining routes between all points on the network using the shortest path. It measures the through-movement potential of a street link and is proportional to the estimated count of movement passing through the link from and to all other parts of the network (Sarkar et al., 2015). This measure shows high correlations with vehicle flows (Turner, 2007) and pedestrian movements (Chiaradia et al., 2014; Hillier & Iida, 2005). In that sense, we decide to use as shortest angular path, the route that minimizes angular change, which is widely used as a measure of potential movement (Cooper et al., 2014; Dalton, 2003; Turner, 2007). The reason is that routes with fewer turns are usually easier to remember, reducing cognitive efforts (Haque et al., 2007; Richter, 2009; Wiener et al., 2008). Based on this previous choice, we model the morphology of the built environment using morphometrics calculated through algorithms included in the spatial Design Network Analysis (sDNA) (Chiaradia et al., 2012). We consider the Two-Phase Betweenness parameter for each street link as a proxy of probability of people-flows passing-through the street link and consequently the criteria to measure the business objective in our study area. We calculate it using the following formula:

$$\mathbf{TPBt}(x) = \sum_{y \in N} \sum_{z \in Ry} OD(y,z,x) \frac{W(z)P(z)}{\text{total weight}(y)}$$

where total weight(*y*) is the total weight in radius from each *y*. In this formula, *y* and *z* are origin and destination points respectively, and the origin weight is distributed over destination weights. It is thus the sum of geodesics that pass through a link *x*, weighted by the proportion of network quantity accessible from geodesic origin y that is represented by geodesic destination *z*.

The difference between regular betweenness and Two-Phase betweenness is that the later assumes each origin has a fixed amount of weight it can add to betweenness. This fixed quantity is then divided proportionately among the destination weights accessible from that origin for the current radius (Cooper et al., 2014). We define business failure as a retailer having not enough customer traffic due to its localization in the city map. Consequently, we set as business criteria, the condition for the new shop to have a Two-Phase betweenness score higher than the average betweenness of all the shops of the same neighbourhood. We consider accordingly that if this novel shop does not fulfil this criteria, it predicts that its business performance would be directly impacted and would entail to business failure.

3.2. Social criteria

Only the new shops localized in the streets of the city that conduct to the schools can play an educational role and become a 'reference/friendly' shop (Grimaldi and Fernandez, 2017). Additionally, if the objective is the children have always a reference point in their visual field, the shop has to be situated close to an existing friendly one. We analyse the average distance to consider, i.e., how much the children should walk between two friendly shops. Several studies (e.g. Ben-Joseph & Szold, 2005; Frey, 1999; Keating & Dennis, 2000; Martín-Ramos, 2012; Neuman, 2011) aim at determining the suitable visual field or the maximum distance that can be covered without facing a physical object or obstacle considering environmental, social, architectonic and economic aspects.

The analysis of their respective conclusion shows that a large divergence of opinions exists regarding the 'pedestrian friendly average distance'. Options vary between 40, 50, 113 (model of Barcelona 'Eixample' district), even 200 meters for US cities. For our study, we decide to consider fifty (50) meters as the average maximum distance that the children should walk between

two ‘friendly shops’. Consequently, a vacant space can become a friendly shop if it is at less than 50 meters from one of any other existing friendly shops.

3.3. Heuristic

We develop the following heuristic which aims at selecting amongst the list of vacant locations the shops that cover the two business and social criteria already described.

Data: List of the open shops with their localization in the neighbourhood (L_{open})
Data: List of the vacant stores with their localization in the neighbourhood (L_{vacant})
Data: List of shops part of the social project (SP) in the neighbourhood (L_{srp})
Pre-Process:

begin
Build a matrix calculating the shortest distance between the vacant stores and the shops which participates in the SP (M_{com})
Build an empty list with the partial solution where to add the selected vacant stores (LP_{sol})
Build an empty list with the final solution where to add the selected vacant stores (LF_{sol})
end

Process:

begin
while *the list of vacant stores (L_{vacant}) is not empty* **do**
Select the first shop (S_{vacant}) from the list of the vacant stores (L_{vacant})
Select the shop (S_{srp}) from the list of the shops which participate in the SP (L_{srp}) closest to (S_{vacant}) according to (M_{com})
if *the distance between both selected shops (S_{vacant}) and (S_{srp}) is between 0 and 50 meters* **then**
Add the selected vacant store (S_{vacant}) to the partial solution (LP_{sol})
end
Remove the selected vacant store from the list of vacant stores (L_{vacant})
end
Calculate the average betweenness (AB) of the network of the open shops (L_{open})
Calculate the betweenness (L_{betw}) of the previous selected vacant stores (LP_{sol})
Add every selected vacant stores (LP_{sol}) to the final solution (LF_{sol}) when its betweenness (L_{betw}) is greater than the average betweenness of the network of the open shops (AB)
end

Algorithm 1: Heuristic of the nearest friendly shop

4. Computational experiment

4.1. The case of Sant Andreu

To test the efficiency of our novel approach, we decide to select the popular district of 'Sant Andreu' located on the eastern side of the Barcelona city. We run six meetings with managers of the Barcelona City Hall from IT, Economic Promotion, Education, Urbanism, Procurement and Sant Andreu district departments. We find from these meetings that each department is quite working separately which makes difficult to have a holistic view of the city and what it is going on in terms of business activities or people flows. From our meetings, we are able to know that 'Sant Andreu' counts 3.435 local shops distributed as described in the table 1.

Sector of activities	Percentage
Goods for house (furniture, clothes…)	6.1%
Goods for men & women	9.4%
Culture & Entertainment	3.5%
Eating & Drinking	15%
Professional services (lawyer, real-estate, dentist...)	37.8%
Bars & Restaurants	16%
Private Transports (dealership, private bus...)	5.5%
Closed locals	17.2%

Table 1: Commercial distribution of Sant Andreu district

The manager of Economic Promotion informs us that regardless the recent financial crisis that the whole country has suffered, the large infrastructure works initiated in 2009 to create a fast-speed train station in the centre of the neighbourhood (called 'Sagrera') have drastically hindered the pedestrian mobility and largely explain why 777 small businesses are vacant or closed today. The manager of Education department adds the neighbourhood of 'Sant Andreu' joined in 2.000 the initiative of 'the Road to School' and indeed formed part of the study realised by Grimaldi & Fernandez (2017).

We were looking for the information regarding the localization of the urban shops. We find that any department of the City Hall was able to provide this 'gold' information and we actually realise that neither public institutions (region government, central government) nor private ones (bank, real-estate…) were able to provide it contrary to what we believed and expected at the beginning of our interviews. Following a suggestion of the manager of City Hall IT department, we contact the CEO of Eixos, a company based in Barcelona (www.eixos.cat). We found that they actually detected this market failure few years ago and decided to transform it into an opportunity for urban venturing. They developed a method collecting directly the localization data down on the street based on a crowdsourcing model and leveraging the use of the Big Data analytics. They employ an international group of geographers that they connect through Twitter social media network. Each geographer is assigned to an urban area that he has to walk fulfilling a web-based

formulary in his mobile companion. All the collected information is then uploaded and stored in a Hadoop Database.

We ask Eixos to provide with the information regarding ‘Sant Andreu’ neighbourhood to test the efficiency of our heuristic. We want to investigate the accuracy of our predictions about the retailers’ business performance and the improvement of the ‘Road to School’ social project both together. They use Quantum GIS (QGIS) software platform, a free and open-source desktop geographic information system (GIS) application, to execute our heuristic. QGIS allows to create maps composed of either raster or vector layers and based on the geo-localization of all the shops (vacant or open). The vector data is stored as either point or line or poly-line and allows to provide data viewing, editing, and analysis. ‘Sant Andreu’ neighbourhood has a grid structure comprised of 720 streets links and 1.762 nodes. We decide to choose as scale of interest (the network radius) the distance of 1.0km for our betweenness computation. One km permits to reach the whole neighbourhood and is a possible distance to travel by foot to go to work or for shopping, outdoor activities, etc. They determine the average Two-Phase betweenness of all the shops is 117. Consequently, the locals selected by our heuristic have to have a Two-Phase betweenness above this value.

In summary, the data from ‘Sant Andreu’ for the heuristic are:

- A list of 3.435 open shops with their localization in Sant Andreu, (Lopen)
- A list of 777 vacant stores with their localization in Sant Andreu (Lvacant),
- A list of the 135 shops participating in the School Road Project (SRP) in Sant Andreu (Lsrp).

4.2. Analysis of the results

We code and execute a R-program which randomly selects locals amongst the list of 777 vacant ones. We run this program 100 times. We obtain a sampling of data which is statistically enough representative to be contrasted against the results issued by our predictions. This comparison has the objective to check the efficiency of our heuristic and our results are presented hereafter. The figure 2 draws all the streets of the ‘Sant Andreu’ neighbourhood. On the left, betweenness is represented by a colour code: red for higher and blue for lower scores and on the right as a heat map of colour with its intensity gradation. We observe five main and long red lines which unsurprisingly are the main commercial arteries of the neighbourhood. The right side is the bordering zone to the large infrastructure works realized for the Sagrera fast-speed new train station which is still in progress after many years. Many streets in this ad-hoc area are vacant off converted in cul-de-sac. That explains why they appear as blue lines.

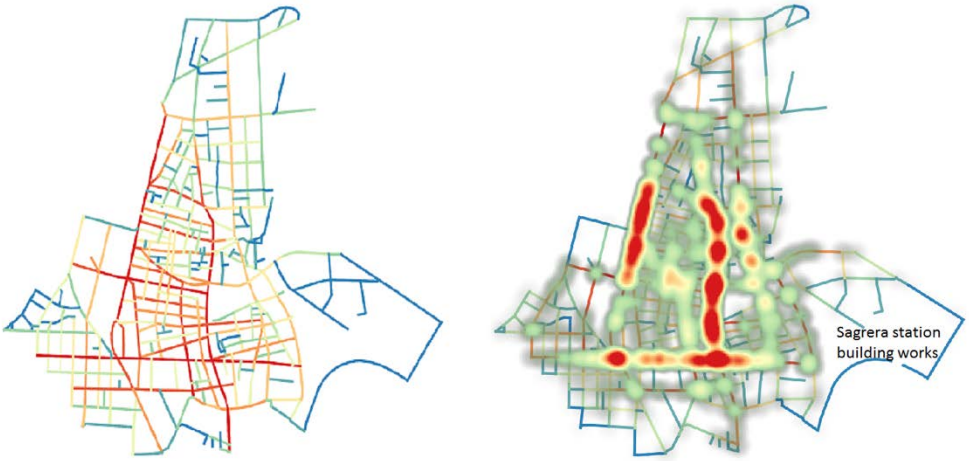

Figure 2: Betweenness representation

After executing the heuristic defined in the methodology section, we obtain our results that we compare with the sampling of data randomly built. Our findings are presented in the figure 3. Our heuristic has selected 50 vacant stores according to the business and social criteria already explained. The situation as of today is represented in red, the blue represents the result of our prediction, i.e., the situation of today and adding 50 shops coming from the execution of the heuristic. The green shows 100 possible future situations, result of the situation of today and a set of 50 locals randomly selected. These 100 situations are possible random scenarios that could occur tomorrow if our method is not applied (free market mechanisms and conditions).

The results of our heuristic are only 50 vacant shops have a Two-Phase betweenness above 117. They improve the average distance from 61.60 to 46.96 meters which satisfies the social and second objective to be below the 50 meters' target. The use of location information allows to make a prediction on business and social performances for a business-led urban regeneration. Amongst the sets randomly selected, 96% has an average distance higher than the heuristic one and 100% has an average betweenness lower than the heuristic one. However, there is no set of data randomly built that improves both criteria together: higher betweenness and lower average distance than the heuristic-based results. Therefore, we can affirm that our heuristic makes a better prediction at 96% on social performance, at 100% on business performance and at 100% considering both criteria together.

The figure 4 shows on the left with green circles the current network of 135 friendly shops and on the right, suggests how this network would be if we add the 50 vacant stores determined by our heuristic (in red colour).

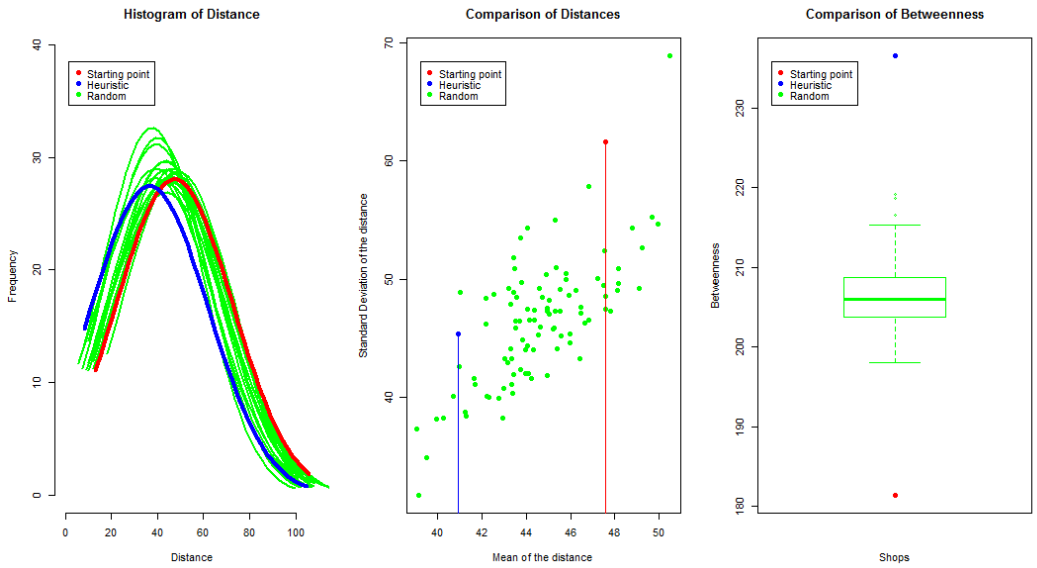

Figure 3: Business and social criteria

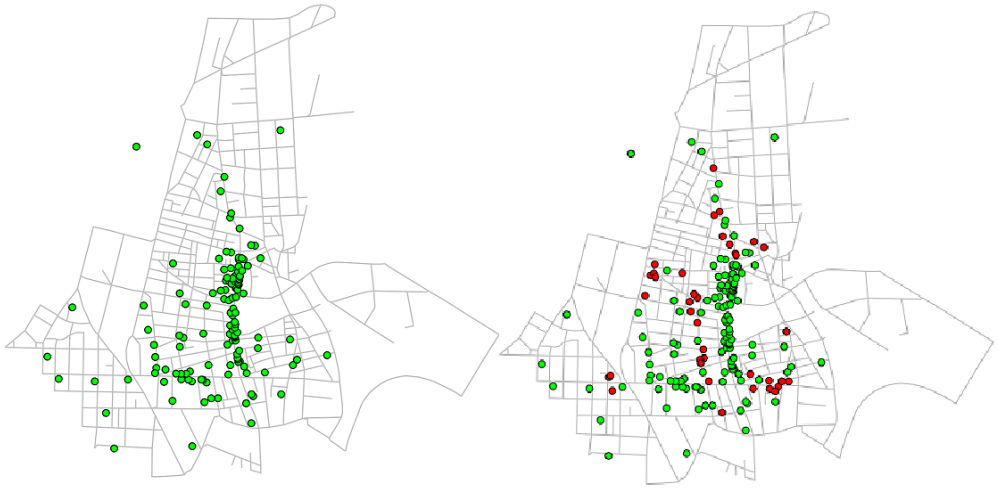

Figure 4: Localization of the friendly shops before and after the heuristic

5. Discussion and conclusions

The aim of our study is to develop a heuristic to identify the localization of future shops with the double objective to cover business and social objectives together. Our study stresses the role that can play the science to organize an urban regeneration. Our resolution of a social and business concerns by the application of mathematics and physics knowledge corroborates the evolution noticed during the last century about the convergence of social, business and technology sciences (Spohrer & Maglio, 2008).

5.1. Uniformity and 'mono-business activity'

The application of our heuristic has resulted to geographically distribute the opportunities of business creation across the whole zone of the district as the figure 4 shows it. It constitutes a positive result against the uniformity and 'mono-business' trend occurring in the main cities in the industrialized world. Indeed, Judd & Fainstein (1999) argue that the natural mechanisms of a

business-led urban regeneration in a free market lead cities to become more and more similar through the supply of standard chain hotels, bars, restaurants and touristic retail establishments (e.g. clothes, shoes) confined in specific areas. Ritzer et al. (2012) state moreover that the character of a city is often lost when local and historic restaurants and shops are supplanted by large corporate chains. The authors add that letting the free market to decide on the urban regeneration increases the risk to transform streets, or part of the neighbourhood filled up by shops with the same business activity that attract tourists. Swarbrooke (2002) argues that standardisation and 'mono-business activity' lead to a loss of local identity for cities which produces paradoxically the contrary effect, reducing the long-term appeal and sustainability of destinations.

Our heuristic spreads the localisation of the new shops and already opposes to this uniformity. Nevertheless, we suggest to extend it including the specialist nature of the small stores to bring more diversity, 'colour' and choice to the retail offer (Smith & Sparks, 2000). The presence of different retailers offering non-standard products brings relief to the landscape of the monotonous malls based of similar multi-retailers offer. It could be for the independent retailer a strategy to compete and win against the e-commerce channels while shopping malls with its advantage to give price discounts are losing their commercial battle against internet. The real-estate research firm Cushman & Wakefield recently corroborates it through its evaluation of the declining number of visits in the USA molls by 50% between 2010 and 2013[1].

5.2. Dilemma of the gentrification process

Our results show a positive social and business impact by the opening of new 50 shops. The question remains of 'who' actually benefits from the urban regeneration that proposes our heuristic: the local resident, the tourist, the social or the 'creative' entrepreneur? (Colomb & Kalandides, 2009) In many cases, evidence points out to the negative impact of regeneration on local community groups owing to the domination and interest of business developers to meet the needs of upper-income consumers and tourists. Indeed, there is the danger of commercial overdevelopment, in detriment of recreational open space and lower-income housing for residents (Vojnovic, 2014). The process of physical gentrification as described by Holm (2010) could occur, i.e., an upgrade of the building blocks by 'urban pioneers' (Overmeyer, 2005) followed by changes in the tenure patterns which increases in rent and the gradual displacement by higher income groups of the existing residents and the social or creative entrepreneurs who can no longer afford the rise of the renting costs. Even the recent studies concerning the temporary use of space as an alternative to permanent solutions show potential benefits which indicate opportunities for producers but also vulnerability for others who are driven by necessity instead of choice (Madanipour, 2017). The social objective provides thus an unexpected and non-desired effect (Harris, 2015).

Furthermore, people may have different perceptions of the ideal neighbourhood and hence, there are often conflicts between social and commercial interests. Hall (2013) states that residents want to see non-profit initiatives such as parks and associative centres, while entrepreneurs are interested to maximise commercial profit. We believe that our heuristic by mapping the city business activity and modelling it gives an opportunity for the public administration to control the situation of the neighbourhood and decrease the risk of gentrification. But it supposes of course for the city managers to develop an economic observatory to evaluate and monitor the impact on the inflation of the consuming goods, to follow the evolution of the locals and flats renting costs

[1] http://www.businessinsider.com/the-retail-apocalypse-has-officially-descended-on-america-2017-3 (last visit on 22/3/18)

and if possible the nature of the new shop owners to avoid possible financial speculation based on the reclassification of deprived areas to commercial zones.

5.3. The use of the science as part of urban regeneration policy

Our results argue the new business features of a city is not deducible from the characteristics of an individual household or an establishment (how much can I sell or rent this space?) but measuring and analysing the dynamical flows and topological properties of the networks that innervate the different layers of the city (traffic of cars, people in the streets, railway networks, etc.) (Samet, 2011). The use of betweenness has demonstrated its utility to design business-led urban planning. Nevertheless, we believe that other variables could be leveraged continuing the application of the complexity science to networks (Newman, 2010). In that direction, Samet (2013) introduces factors to analyse the smart city structure (built surface, dwelling cost per m2, density by zone) and its population that future lines of research should include to improve our predictive model.

Other authors (e.g. Brown, 1991; Dennis et al., 2002; Reimers & Clulow, 2004; Roig-Tierno et al., 2013) argue that determining the best location in the city for local retail is a more complex decision and responds to specific buying comportments and types of competition that they classify in two different categories. The first one is named the 'comparison' behaviour. It refers to the type of sales which requires a comparison of style, quality and price between different brands/shops selling the same type of article (e.g. clothes, shoes or electronic devices). The second category is called the 'convenience' shops where the buyer is looking for commodity, very short proximity and easiness to buy the article he needs (e.g. pharmacy, baker, groceries, tobacco). Convenience businesses are usually built with a cost-leadership strategy and have a large availability of the service or product that they supply. They need to be located far the ones from the others to be financially sustainable. On the contrary, comparison shops belong to a same cluster and are physically closer between them to permit to the clients the assessment and the selection. They usually develop a differentiation and/or niche strategy (Porter, 1991).

Our results provide a list of 50 potential opportunities for local retail. They should be upgraded to provide a recommendation of the business category (commodity or comparison) for each shop in function of the positioning of the existing competitors, complementary or substitutes. It will improve the business criteria of the selection process. Our study by providing a heuristic introduces a method for public administration to promote a new model of urban governance. We recommend including it in the urban regeneration plan as a transversal tool for the smart city strategy to influence the free market mechanisms and conditions. This algorithm could be an input for the application of corrective bonuses to influence the choice of business activities or hours. For instance, a fiscal bonification could be given for entrepreneur that opens a business aligned with the opening hours of the shop with the school start and open hours (9:00-16:30 in Spain). Nevertheless, we recognize the difficulty to properly calibrate these taxes to determine how many specific shops we need in each neighbourhood. Indeed, some recent experiences show that this approach has some risk to decrease the investment attractiveness and to limit the regeneration (e.g. Pigou, 2013).

We think moreover our findings should impact the strategy and the operational processes of different departments of the City Hall such as the Economic Promotion, the Social Services, the Education, or the Urbanism. Since moving the City Hall working more together. While breaking the different silos is a difficult reform to manage (Boschken, 2009; Francesca & Sylvain, 2010; Tett, 2015; Vine, 2008), we suggest the creation of a special agency in charge of the coordination.

This agency could constitute working groups with representative of each municipal department. Its objective would be to make the urban business creation easier, the monitoring of the public efficiency and the matching of social and business interests. UK recently started the creation of such agency called Business Improvement District[2]. The services provided by BIDs are supplemental to those already provided by the city. The revenue derives from a tax assessment on commercial property owners, and in some cases, residential property owners[2]. The district of Sant Andreu launched this initiative in beginning of 2018.

[2] https://www.gov.uk/guidance/business-improvement-districts (last visit on 22/3/18)

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