Evaluating Retailers in a Smart-buying Environment using Smart City Infrastructures

Dimitrios Amaxilatis
Computer Technology Institute and Press "Diophantus"
and
Department of Computer Engineering & Informatics
University of Patras, Greece
amaxilat@cti.gr

Kalliopi Giannakopoulou
Computer Technology Institute and Press "Diophantus"
and
Department of Computer Engineering & Informatics
University of Patras, Greece
gianakok@ceid.upatras.gr

***Abstract*—In modern cities, most citizens are interested in buying from e-shops or mostly buy from large shopping brands. This is a challenge for small and medium-sized retailers, who cannot afford to maintain IT infrastructures and skills. The ongoing R&D project SMARTBUY, tries to close this gap by providing a platform for small and medium-sized retailers to become the place where they can easily make their products and promotions visible online for local audiences, along with a mobile application for customers. An important issue in this context is the evaluation of the retailers. In this work, we introduce a new evaluation application for assessing the quality of the retailer services. Customers have the chance to rate the behavior and the offers that the retailers provide to them. This evaluation service is based on the SMARTBUY platform and is developed upon the OrganiCity Experimentation Platform. The evaluation application is a novel approach to generate knowledge for the retailer shops inside a future city using both data from open city datasets as well as feedback from citizens. Such an application is deemed useful to both customers, to identify retailers with best offers and services, and retailers as an incentive to improve their services.**

Keywords—smart cities; IoT; mobile application; evaluation of retailers.

I. INTRODUCTION

Currently, we are witnessing a new shopping trend, showrooming [1], which refers to the situation when a shopper visits a store to check out a product, but then purchases the product online, from home. This is the case since many people still prefer seeing and touching the merchandise they buy, while many items are available at lower prices through online vendors. As such, local stores essentially become showrooms for online shoppers. In the past few years, as online shopping exploded, and smartphones became the norm, the showrooming phenomenon seemed to highly threaten store-based retailers. But now, retailers have discovered *reverse showrooming*, or *webrooming*, which is when consumers go online to research products, and then head to a bricks-and-mortar store to complete their purchase. Reverse showrooming is nothing new. Since the early days of online shopping, more people have researched their shopping online than bought there. What has changed is that small and medium retailers have begun to identify the reverse showrooming trend and the opportunity it offers to them and are now working to actively recapture those sales. Reverse showrooming is in fact more common than showrooming. At the same time, social media has also become a major referral source for bricks-and-mortar chains, not just e-commerce sites. But only recently have traditional retailers begun to capitalize on reverse showrooming [7]. Offline retailers have realized they can utilize offers, as long as they can integrate offline and digital experiences via the online services provided by the product manufacturers to beat e-commerce competitors on convenience. The retailers getting more benefit from this trend are the big ones. Additionally, big stores can offer an online and an optimized offline buying experience, as well as offer in-store pick-up of online orders, in-store Wi-Fi and an online sales infrastructure. They can be present at big commercial areas, malls, and they can rent big buildings for optimizing the purchasing experience. Small retailers are in risk of losing a big opportunity with the rising of in-store sales triggered by the rising of the webroomer trend [2]. Small and medium-sized retailers must find their way to become the store were the webroomers finally go to finalize their purchase process. They have the advantage of being able to provide their customers with convenient and local access to stores.

Most retailers belong to the category of Small-Medium Enterprises (SMEs), which face a lack of visibility in the digital world. Nearly 40% of small businesses in Europe do not have a website, and only a few have their product catalogs online. They are not visible on large commercial platforms. In addition, the use of commercial platforms is very costly for SMEs. Furthermore, many customers would be interested to support their local retail SMEs even, buying from them instead of buying from large e-Commerce platforms. However, it is difficult for them to do so in absence of online platforms specifically dedicated to SMEs. For small retailers who want to develop e-commerce locally, it would make sense to cooperate together at local level and create a local online catalog of products where they could advertise to local consumers. Individual SMEs may lack necessary IT skills and visibility online, but if such a platform is created it would benefit all the small retailers involved. Retail SMEs should obtain help to create such platforms at the local level. In particular, help linked to IT skills and marketing would be necessary.

A recent R&D effort through the SMARTBUY project [3] aims to narrow this gap between small and medium-sized retailers and their customers using technological infrastructures. The goal is to become *the online place* for

products and promotions for local audiences at the right time. This place is the customers' smartphones, providing them also with relevant advantages of e-Commerce: comparison of prices, choice of providers, reviews and specification awareness, booking, etc. The SMARTBUY platform provides SMEs retailers with an integrated suite of services allowing them to apply the tactics that the big retailers are now using to offer an integrated digital and physical buying experience to customers. The status of the retailer platform and the mobile application for customers, along with the benefits of the SMARTBUY services can be found in [3]. The assessment of SMARTBUY services is carried out by exploiting the Internet-of-Things (IoT) infrastructure which most modern cities offer.

In this work, we describe a new service that concerns the evaluation of retailers by customers. This SMARTBUY service is built on top of the OrganiCity smart city platform which offers an Experimentation-as-a-Service (EaaS) framework that can be used to perform large-scale experimentation with citizens in multiple cities around the world. Our application operates on top of OrganiCity, using the provided tools and services to enable citizens to evaluate the retailers they have interacted with, and share this evaluation in the context of their cities. This application can be used either via web interfaces, be integrated directly inside a smartphone application or even the retailer's website, or social media profiles if available. Our application focuses on providing proof that it is possible to simply develop such an application by combining the two services requiring the minimum amount of time, effort and technical expertise.

The evaluation application, on the one hand, is deemed useful to customers to identify retailers with best offers and services, and on the other hand, incentivizes retailers to improve their services.

II. Preliminaries

A. OrganiCity, a service for Experimentation in Smart Cities

Traditionally, cities have been the meeting point between societal challenges and technological innovation. Nowadays, most of the people in Europe live and work in cities and soon the population in urban environments will further increase. Cities will need to deal with the demand for novel services, while their infrastructures will gradually become outdated. These aspects can hold back city innovation, so that the application of Future Internet technologies will be an enabler for the transformation of traditional cities into smarter cities. The goal of a *smart city* is to create an environment where technology and services coexist with the users and citizens to solve issues of their everyday life. The sustainable management of the traditional city services like transport, energy, waste management, health and social care for dependent people are scenarios where the clear use of IoT and Future Internet technologies provide building blocks for setting up the smart city paradigm.

We base our work on the concept of *OrganiCity* [4] and its *Experimentation as a Service framework* [5]. OrganiCity, based on the outcomes of the SmartSantander project [9], helps cities grow organically with the involvement of the different stakeholders (citizens, communities, scientists, developers, and others), and not be driven solely by engineering visions. It also allows developers, and researchers to create their own applications quickly and easily using the provided datasets and tools to experiment with new ideas and innovative solutions. The main problems researchers face when developing an application in the context of a smart city, is locating the datasets required to gather the information of the cities, and consuming such data in a uniform and well-established format. OrganiCity offers in that line a cross-city interface for accessing city data, as *attributes of assets* that represent points of interest inside the city. Assets are fully searchable and indexed resulting in a hassle-free setup of the application's dataset. Also, based on to the common format used in each site supported by OrganiCity, developing an application that can be deployed in multiple locations is guaranteed.

B. The Phenomenon of Webrooming in Smart Cities

Webrooming is the practice of researching an item online before visiting a local store to complete the purchase. The novel smart city model is meant to serve as an incubator for the development of a diverse set of highly innovative services and applications. Setting up an experimental facility inside a city means providing real-world conditions along with the necessary infrastructure for a Smart City that will rely on IoT technologies. The scale and heterogeneity of such an environment make this deployment extremely valuable for scientific and technical research. This city-wide context is intended to attract the necessary critical mass of experimental businesses and end-users that are required for testing on a large scale, as well as combine it with other Future Internet technologies for market adoption.

OrganiCity intends to provide a holistic citizen-driven approach for optimizing the city by combining the physical space with the digital. SMARTBUY benefits from the infrastructures provided by OrganiCity, to guarantee the involvement of citizens, authorities, and stakeholders in the collaborative process that allows the implementation of a SMARTBUY space in cities. The assurance of the availability of IoT and other smart-city infrastructures allows the deployment and the provisioning of SMARTBUY services. Due to the cooperative nature of OrganiCity, it will also enable the co-creation process needed for a successful and replicable deployment and validation of such services in different cities. Moreover, it guarantees our evaluation will be performed in a large-scale heterogeneous environment allowing for validation of the hypothesis about the competitiveness increase of SME retailers in a real-world environment.

III. The SmartBuy Platform

The SMARTBUY platform [3] provides the technological infrastructure for small and medium-sized retailers to become *the place* where they can easily make their products and promotions visible online for local audiences at the right time

and at the right moment; just in their smartphones and providing them also with relevant advantages of e-Commerce: comparison of prices, choice of providers, reviews and specification awareness, booking, etc. SMARTBUY provides SMEs retailers with an integrated suite of services allowing them to apply the tactics that the big retailers are now using for offering an integrated digital and physical buying experience to customers. SMARTBUY is thought as a service that achieves its bigger potential when applied in a limited geographical area with commercial stores density such as a city. The service provides an e-Commerce location-based (L-Commerce) integrated infrastructure for all the small retailers in a geographical area (i.e. a city) to use. The e-Commerce infrastructure allows conducting centralized searches of products provided by the stores. Customers can get access to real time information of the products, prices, availability, etc., with the convenience of being able to physically purchase in a local, near-to-home store. SMARTBUY converts Smart Cities' physical stores in a smart geographically distributed mall by providing the logical consistency needed for conducting centralized searches in heterogeneous and geographically distributed physical stores.

A. The Evaluation of the Retailers

The evaluation scenario of retailers refers to the opportunity the customers have to evaluate the retailer's attitude and services. More specifically, the customers will have the chance to rate the "Quality of the Service", the "Politeness", the "Value for Money" and the "Discount Policy" of the retailers according to their experience. These values have been identified also in similar research studies [8] to be the most crucial in building a trust bond between the local retailers and their customers.

- *Quality of the Service* refers to the service-quality delivery of a store and it has a major impact on the consumer's behavior regarding a shop.
- *Politeness* assesses the kindness and politeness of the retailer to the costumers.
- *Value for Money* refers to the quantity and quality of the purchased goods that will be exchanged for one monetary unit.
- *Discount Policy* assesses the overall strategy and possible deals that a certain retailer provides to its customers along with the final profit for the customer.

All the above measures have a Linkert scale from 1 to 5. The number 1 illustrates the worst rate and the number 5 the best rate. Under this framework, an overall retailer ranking can be created solely based on the opinion of customers. Such a ranking will be useful to other customers when selecting a retailer for their shopping, and a motivation for the retailers to improve their services and offers to become more competitive.

IV. The Evaluation Application

We develop our application as a web and smartphone based application using the OrganiCity Experimentation as a Service framework and the tools it provides. Specifically, we base our design on representing each retailer that is available in the city as an Asset of OrganiCity, that is searchable and available to all citizens using its location and the services offered. Our application leverages a set of OrganiCity tools to provide a listing of all available retailers around the user, evaluate the retailers and provide feedback for the quality of each retailer. In more detail, we use the **Asset Directory** to store and list all the retailers that participate in the evaluation. The Asset Directory is an open catalogue that contains all available points of interest inside a smart city, ranging from shops, monuments, cultural events to bus routes and stops, timetables, and Internet of Things devices with sensors like traffic counters and pollution meters. Our contributions are part of an *experiment*, set up in OrganiCity containing all the retailer's information including the name of the shop, the location, and a description of the shop's services. Secondly, we use the **Annotation Service** to allow users to provide feedback for the retailers. This service allows us to generate a set of characterizations for users to apply on each retailer.

A. Describing the Retailers

In Fig. 1, we present how each retailer is represented in the main portal of OrganiCity and how citizens can view it to through OrganiCity. All points of interest in OrganiCity are called Assets. Each Asset is identified by a unique id that follows a pre-defined format starting from its membership in the smart city or an experiment, and containing its grouping and a self-describing suffix. Following this format, this id is unique across whole platform and easily filtered. Assets also have a type identifier that categorizes them and provides an easy first level differentiation inside the whole directory of the platform. Apart from those two several additional attributes can be used. In our case we use the following:

- *"location"*: contains a latitude longitude pair as a GeoPoint to describe the retailer's physical location inside the city. The physical location can be used to run spatial queries for retailers near the citizen's location.
- *"description"*: provides a free text description of the products the retailer offers. This description can be used to perform text-based search for limiting the results when citizens search for specific categories of retailers.
- *"name"*: the name of the retailer's shop, that can be used for display and search purposes.
- *"contact"*: various contact methods can be used to allow citizens to contact the retailers directly for information about their shops or products.

Identify applicable sponsor/s here. If no sponsors, delete this text box (*sponsors).*

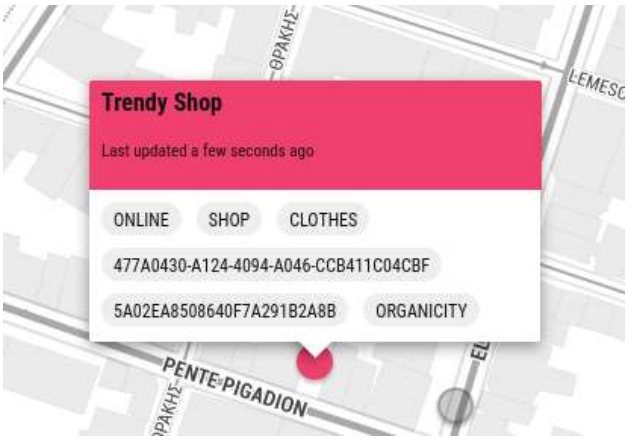

Fig. 1. Representing Retailers as *Assets* inside the Smart Cities on map

Fig. 2 shows an example of how these data are formatted and provided to experimenters through the RESTful[1] interface of OrganiCity. Such a JSON based format, is commonly used amongst many web applications and services, making it extremely easy to develop additional applications on top of the data available by the platform. Also, the format available above, is identical to the one used for describing additional Asset types available inside the OrganiCity platform like bus stops, monuments or IoT devices along with their collected data.

```
{
  "id": " urn:oc:entity:experimenters:…:…:pshop1023",
  "type": "urn:oc:entitytype:shop ",
  "location": {
    "type": "geo:point",
    "value": "38.25911,21.7417465" },
  "name": {
    "type": "urn:oc:attributeType:name",
    "value": "Trendy Clothes"  },
  "description ": {
    "type": "urn:oc:attributeType:description",
    "value": "Clothes Shop in E.Stratiotou, Patras…."  }
}
```

Fig. 2. Representing Retailers as *Assets* using a JSON

B. Defining the Evaluation Criteria

The second step, is for us to define the evaluation criteria to be used. The criteria in the Annotation Service of OrganiCity are defined as Tags. Each tag describes one of the characteristics of the retailer as described in Section II.A. In more detail we focus on "Quality of the Service", the "Politeness", the "Value for Money" and the "Discount Policy". For each one of the 4 evaluation fields we create a TagDomain that groups the Tags that refer to it. The generated taxonomy for the retailer evaluation is presented in Table I. For each one of the Tag Domains, we assign a value of 1 to 5, with 5 being the best value a retailer can score. Using this scoring method, it is possible to generate for each citizen that evaluated a specific retailer a summary evaluation based on the individual scores and a weighted summary based on the formula that can be adjusted. In a uniform evaluation all scores can contribute with a 25% to the final evaluation of a retailer, but in a more advanced context, citizens can select the evaluation fields that are more important for them and adjust the contribution to the final values.

[1] https://en.wikipedia.org/wiki/Representational_state_transfer

TABLE I. THE TAXONOMY USED FOR THE RETAILER EVALUATION

Evaluation Field	*Tag Domain*	*Tags*
Service Quality	qualityofservice	excellent good medium bad unacceptable
Politeness	politeness	excellent good medium bad unacceptable
Value for Money	valueformoney	excellent good medium limited unacceptable
Discount Policy	discountpolicy	generous good normal limited none

The generated Tags and Tag Domains are registered to the Annotation Service of OrganiCity using the available restful API and the generated JSON objects are presented in Fig. 3.

C. Volunteer Based Evaluation of Retailers

```
{
  "urn":"urn:oc:tagDomain:politeness",
  "description":"Describes a Retailer's Politeness",
  "user":"477a0430-a124-4094-a046… ",
  "tags": [
    {
     "urn":"urn:oc:tagDomain:politeness:good",
     "name":"Good"},
    {
     "urn":"urn:oc:tagDomain:politeness:unacceptable",
     "name":"Unacceptable"},
    {
     "urn":"urn:oc:tagDomain:politeness:excellent",
     "name":"Excellent"},
    {
     "urn":"urn:oc:tagDomain:politeness:medium",
     "name":"Medium"},
    {
     "urn":"urn:oc:tagDomain:politeness:bad",
     "name":"Bad"}
  ]
}
```

Fig. 3. The Evaluation Taxonomy for *Politeness* in Organicity

The last step, is for the citizens to do evaluate the retailers via web or smartphone based interfaces. To facilitate this, OrganiCity offers us two approaches. The first approach is to use directly the **Urban Data Observatory (UDO)**. This service offers a map like interface where citizens can freely browse the map of their city and see all the Assets available,

search for them using keywords or their location. In this approach, the UDO offers a special interface that is populated based on the Tags defined for experiment Assets as a question to the citizens. This interface allows users to characterize the asset representing the retailer with a single click, via the interface presented in Fig. 4.

Fig. 4. Example interface from the OrganiCity UDO for evaluating Retailers

Each citizen can select multiple characterizations from the available ones and modify them in the future, changing the total evaluation of a retailer. Contradicting tags (e.g., "pricey" and "low-priced") are grouped in what we call *Tag Domains*. For every tag domain, each user can select at any given time only one tag, and selecting a new one overrides any past choice. The outcome of the evaluation for each retailer is the tag selected by the most users for each one of the tag domains we defined. Fig. 5 shows an example interface for the evaluation of a retailer and its average reputation.

Fig. 5. Example interface for displaying the Evaluation of a Retailer

D. Evaluation-Based Retailer Search

Based on the generated ranking, citizens can then search for products and services inside the city that match their requirements based on both the product specification and the retailer's characteristics. Such an interface could be expressed by an advanced search option, or a general preference in the user's profile that automatically ranks the generated results. On the other hand, retailers can have access to a dashboard system that presents them with information about their rankings and their overall evaluations by their clients. Then, based on the results they could be able to adapt their behavior towards their clients and their store policies. Such information can then be fed back to the rest of the SMARTBUY services at their disposal to further promote their business.

V. Conclusions

This paper has presented some of the basic principles for developing an application that targets the evaluation of retailers in the context of a smart and connected city. We presented how the two fields of research, smart-retailing and smart cities can be linked and combined to help small and medium size businesses compete in fair terms with the international giants that have access to advertising and promotional campaigns. The proposed application can provide an easy-to-use interface that is well established in the context of OrganiCity and can used to extract valuable statistics about the qualities of local retailers when compared with brand shops. As part of our next steps we plan to run a campaign in the local cluster of Patras for the evaluation of multiple retailers using the proposed application and extract the level of trust that exists between them and their customers.

Acknowledgment

The authors are indebted to Ioannis Chatzigiannakis and Christos Zaroliagis for various helpful discussions. This work has been partially supported by the EU H2020 Programme under grant agreement no. 687960 (SMARTBUY) and no 645198 (ORGANICITY).

References

[1] "What is Showrooming?", 2017. [Online]. Available: http://www.techopedia.com/definition/28277/showrooming . [Accessed 19- Nov- 2017]

[2] Center for Retail Research, "Retail Forecasts for 2018", 2017. [Online] Available: http://www.retailresearch.org/retail2018.php [Accessed 19- Nov- 2017]

[3] SMARTBUY project, http://smartbuy.tech/, [Accessed 19- Nov- 2017]

[4] OrganiCity project http://organicity.eu/, [Accessed 19- Nov- 2017]

[5] V. Gutiérrez, D. Amaxilatis, G. Mylonas and L. Muñoz, "Empowering citizens towards the co-creation of sustainable cities" in IEEE Internet of Things Journal, vol. PP, no. 99, pp. 1-1. doi: 10.1109/JIOT.2017.2743783

[6] C. Flavian, R. Gurrea and C. Orus, "Choice confidence in the webrooming purchase process: The impact of online positive reviews and the motivation to touch" in Journal of Consumer Behaviour, vol. 15, doi: 10.1002/cb.1585

[7] N. Fallon, "Why 'Webrooming' Could Bring Customers Back Into Stores", 2014. [Online] Available: http://www.sviluppareaffari.it/vendereoggi/webrooming.pdf [Accessed 19- Nov- 2017]

[8] N. Sana & S. Lamay, "Evaluation of Customer Preferences on Showrooming and Webrooming: An Empirical Study" in Al-Barkaat Journal of Finance & Management, vol. 8 no. 1 doi: 10.5958/2229-4503.2016.00005.9.

[9] L. Sánchez, L. Muñoz, J.A. Galache, P. Sotres, J.R. Santana, V. Gutierrez, R. Ramdhany, A. Gluhak, S. Krco, E. Theodoridis, et al. "SmartSantander: IoT Experimentation Over a Smart City Testbed", in Computer Networks, vol. 61 pages 217–238, doi: 10.1016/j.bjp.2013.12.020