Waste Food Management Actions in Smart Cities around the Globe

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On my honor as a University Student, I have neither given nor received unauthorized aid on this assignment as defined by the Honor Guidelines for Thesis-Related Assignments

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Introduction

For both the current social framework and the future smart city framework we are trying to develop, the surplus of waste food produced by some people in the society and the need for food generated by the others will always be a problem hard to reconcile. According to the US Census Bureau, the poverty rate in the United States was 11.8 percent in the year 2018, which implied that there were 38.1 million people in poverty across the country. For the same year, the World Bank estimated that globally, there were 8.6% of people living below the extreme poverty line, which was defined by living with below $1.9 per day. Among the causes of poverty, lack of access to clean water and nutritious food tops all others to become the most important reason. Although the lack of clean water can be caused by various reasons that can't be predicted, such as human and natural factors, food shortages and lack of access are more properly understood as a problem with social behavior and distribution. In fact, roughly one third of the food produced in the world for human consumption every year - approximately 1.3 billion tons - gets lost or wasted. Simple math will tell that if we are able to manage the waste food smartly, it's possible that all people in need of food could be served. The goals of this research are to understand the opportunities and strategies for improving food management.

The focus of the research and analysis will be targeted at the use of smart city development processes internationally that create technologically enabled interventions that drive socio-cultural change in food recovery and management. Specifically, the findings would be used as references to evaluate the food management condition currently in Charlottesville. Governmental policies and individual party's actions will be taken into account. For the food

management problem in Charlottesville, the final effort is to use smart city development processes to create technologies and drive socio-cultural change within the society the system resides in.

The goal is to propose an idea of an online platform that will integrate the demand and supply ends of food. The advantage of such a platform is to eliminate the opacity of information to a maximum extent so that people know where to donate food and where to find food.

Literature Review

Food waste, followed by food insecurity, has long been a worldwide problem. According to a report by scholars from Vietnam, the per capita food waste in developed countries and developing countries are 107 kg/year and 56 kg/year, respectively, which show that food waste generation between developed and developing countries are quite evident with higher living standards resulting in greater food waste generation (Thi et al, 2015). Such findings justify the emergency to have an effective approach to transfer waste food to something more meaningful --- regardless of the development of a country, reducing waste food will certainly minimize the negative impact on the environment and increase the food source for people in need. Because of the severity of such problems, many organizations in different countries have conducted experiments as well as research, providing insights into potential solutions to the uneven food distribution. Although the circumstances can vary geographically, a review of attempts elsewhere nevertheless helps develop a perspective for Charlottesville.

Having realized the importance of food management, a non-profit association in Verona, Italy started a pioneer project in 2004 with "two intertwined purposes": reducing waste

throughout the food value chain and reducing malnutrition of socially disadvantaged people (Bonomi et al, 2016). While previous attempts to address food donation mainly focused on technological aspects, this project dug into the organizational and managerial aspects, trying to evaluate the effectiveness of its action. Officially launched in 2008, this R.e.b.u.s network connected for-profits companies, charity organizations and government together to quickly respond to food donation and need for food. It used ICT (Information and Communication Technologies) to improve the efficiency of the whole process, which considerably reduced the chance that food went inedible. ICT tools were used to 1. connect three most involved parties (government, companies and charities) 2. help track the path along which food travels from donors to receivers. As a result, in the year of 2012, this action reduced the organic waste in the involved area by 5%. Nowadays, the influence of this project has expanded other Northern cities in Italy and is reducing over 1000 tons of waste food annually. The success of the R.e.b.u.s network enlightens us of the path we can follow to implement the food donation platform. In the meanwhile, it verifies the meaningfulness of smart food management.

A discussion on the governance of a smart city food system in 2015 suggested a better regulation of natural resources and infrastructure within a city so that most of the residents were guaranteed individual healthy lifestyles and affordable essential services (Deakin et al, 2015). Instead of relying on separate groups to solve this problem, this proposal relied more on the effective and reasonable management of a city as a holistic operation by the government. Such practice needs not only the Internet technology but also the data collection of every aspect of a city. Similarly, this research paper also put emphasis on the utilization of ICT tools in smart

cities. ICT tools are also regarded as a key to the "wise management of natural resources" any participatory governance of smart cities stands on.

The disadvantage of individual food management behaviors compared to a collaborative action is also proved by the scholars in China. An article regarding the food insecurity in China discusses the practicality of altruistic food donation by corporates (Liao et al, 2019), where corporate improves its public reputation by distributing the left-over food to the poor people. Such behavior not only reduces the negative impact on the environment but also offers an incentive for restaurants to donate food. However, potential risks include that this philanthropic action may be interpreted as dumping unwanted food to others, which backfires on the original intention. Based on the study of food waste management in Hong Kong, the food donation consists of a considerably small portion in the management system, as companies found limited resources to help handle food surplus in "a better manner" (Lee et al, 2018).

After analysis of food management cases worldwide, integrating resources through smart city information management to bridge demands and supplies has proved to be effective. Within a city like Charlottesville, gathering information would not be a hard task, given the scale of it. Yet, it is essentially to reach people who don't have much exposure to the public sight, as they likely have financial difficulties and lack nutritious food.

STS Framework

To better understand the food management network in Charlottesville, one of the STS frameworks --- SCOT diagram was used to identify the stakeholders. As defined by Pinch and Bijker (Bijker et al, 1987,), a SCOT diagram consists of relevant social groups, in each of which "all members of a certain social group share the same set of meanings and are attached to a specific artifact". Meanwhile, the fact that each technological artifact has different meanings and interpretations for various groups is called "interpretive flexibility". And by implementing "interpretive flexibility", SCOT aims to appeal to more and more groups (Pinch et al, 1984). By listing out the core factors and their sub-components, we are able to recognize the interactions between every pair of components by drawing lines between them.. In this case, we have "Online distribution platform", "Regulations and food handling" and "Knowledgebase for outreach" as the 3 major factors, while the other components will interact with one or more of them. They are inseparable from the food management project: the online platform is the key place where everyone can give to or receive from, and at the same time it keeps track of all the records; regulations generally refer to legislative approval from the government, since such platform is vulnerable to many unforeseen risks, so a well-established document describing the responsibilities of it can be crucial; knowledgebase for outreach is also important for us since it will gather the scattered organizations --- typically, a single organization has limited resources and might the dilemma of oversized inventory of food or overwhelming request for food. Besides those 3 components, I categorized the other components into 3 kinds: third-parties, givers and receivers.

Practicability of Smart City Interventions for Food Management in Charlottesville

The following includes evidence from Charlottesville government website, online statistics regarding Charlottesville food insecurity, and in-person interviews with CVill local community and UVA student group leaders.

Study on the international efforts in food redistribution reveals the possibility of implementation through ICT tools. The value of such smart city tools lies in both connecting involved parties and tracking the food redistributed. It is noted that the success of ICT-based approach usually relies on the comprehensiveness and instantaneity of the information that the system has access to. In addition, Mark Deakin's emphasis on the role of government in food management of a smart city justifies the necessity of an overall supervisor (city government in his study or ICT platform in this research paper). Altruistic food donation by corporates was also an attempt in Hong Kong, yet the result was not quite promising. While companies tried to promote their social reputation through donations, sometimes these actions can be misinterpreted and backfire.

To better shape the food management solution for Charlottesville, both global experiences discussed above and the local circumstances are taken into consideration. For Charlottesville, the city is equipped with most of the essential components: the city scale is relatively small so that information gathering is not painstaking; modern city infrastructures, including public transportation and Internet coverage, are up to standard so that the construction of a distribution platform wouldn't be starting from scratch. However, a preliminary assessment of CVille food system shows that the areas with lower income levels are located far from the city center, where CTS bus routes become sparse, and residents living in that area therefore have "fewer proximal options for food stores and restaurants, due to limitation of transportation" (The

Charlottesville Region Food System, 2006). Hence, how well the platform reaches the farthest corners of the city, where food happens to be most needed, is essential.

To build a channel where waste food can be transported to people in need, many volunteer groups, including UVA Food Assist Group (interview with Kristin Blake, October 2019), Charlottesville sustainability community (interview with Neha Chopra, October 2019) and so on, are working, including in-person food delivery and web application development, to address the problem of food insecurity and food waste within the Charlottesville area. Yet, the groups are striving individually and are focusing on their own area --- for example, the Food Assist Group is primarily based in the University of Virginia and addresses the food problem of underprivileged students. An integration of these separate efforts into one can not only make distributions more efficient through shared resources but also enlarge the population that benefit from the charity actions, filling in the gaps among previously discrete areas. To handle this challenge, a smart platform that integrates the ICT tools is inseparable. This online platform needs to perform mass data collection, process input information, and give feasible commands in a very short time period in order to reallocate the food resource from one corner of Charlottesville to another. It will incorporate the existing food groups, take in the leftover food, and redistribute it to people in need. Engineering knowledge, specifically computer science, is heavily relied on for building the platform. Besides, assistance from local communities also helps advertise the platform so that not only people in need of food can learn about this new resource, but waste food providers, such as Charlottesville restaurants and UVA dining halls, can supply food on a daily basis. Most importantly, given that the areas with limited transportation are most likely food-insecure, collaborations with the local food stores and churches will make

them the final distribution centers for the residents. Since the entire act is non-profit, regulation and financial assistance from the government are necessary. The success of such a platform depends on many factors. Timely food transportation is essential; a professional team for quality check on the donated food is also necessary; frequent website maintenance can ensure that it functions efficiently.

Discussion

Food management is never a simple problem. It concerns the lives of nearly 40 million people in the US and millions of tons of food wasted each year. Previous studies in other countries have justified the feasibility of integrating ICT tools into smart city food management. Based on the situation in Charlottesville, an online platform that connects government, restaurants, local community, and people in need of food will have the potential to reallocate wasted food and enhance the problems of food shortage and food surplus at the same time. Further work, including prototyping the platform, vetting the idea with the local government, and seeking collaborations, is needed to accomplish the project.

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