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*Document Version*

Publisher's PDF, also known as Version of record

*Publication date:*

2023

[Link to publication in University of Groningen/UMCG research database](#)

*Citation for published version (APA):*

Dobber, R., & Buijs, P. (2023). *Policy approaches for placing parcel lockers in public space.*

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# Policy Approaches for Placing Parcel Lockers in Public Space

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**Abstract:** *This paper explores policy approaches for parcel lockers in public space. While last-mile delivery service providers primarily focus on the economic and customer service benefits of parcel lockers, securing approval from local governments to place lockers in public spaces requires justification of their public value. Our study identifies six factors that decisionmakers can consider when evaluating requests for parcel locker placement: carbon emissions, nuisances of the delivery vehicle, nuisances at a locker location, customer preferences, innovation, and the pull effect of parcel lockers. Through a series of semi-structured interviews and a workshop with public decisionmakers in cities across the Netherlands and Europe, we find that delivery vehicle nuisances and potential new nuisances at the locker location are important factors for decisionmakers at local government. Our study reveals two distinct approaches taken by local governments when facing requests for parcel locker placement in public spaces: reactive and proactive. Overall, this study contributes to the understanding of the policy perspective on parcel lockers in public spaces and provides insights for sustainable urban logistics planning.*

**Keywords:** Parcel lockers, public policy, last-mile logistics

**Conference Topic(s):** Omnichannel & e-commerce logistics; PI implementation.

**Physical Internet Roadmap ([Link](#)):**

PI Nodes,  PI Networks,  System of Logistics Networks,  Access and Adoption,  Governance.

## 1 Introduction

Last-mile delivery services are turning to collection and delivery points to manage costs, improve customer service, and reduce their carbon footprint. Collection and delivery points can either be staffed, such as in gas stations and supermarkets, or unmanned parcel lockers. They can be situated on private property, like in apartment buildings or parking garages, or in public spaces. This study specifically focuses on the placement of parcel lockers in public spaces. Public space is limited, particularly in densely populated urban areas, and is subject to the competing demands of various stakeholders. Local governments play a vital role in managing public spaces; consequently, their approval is frequently necessary before parcel lockers can be installed in such locations.

Delivery companies are primarily concerned with the economic and customer service benefits of parcel lockers, which is why most research on the subject concentrates on network and delivery route optimization (e.g., Deutsch & Golany, 2018; Orenstein et al., 2019; Sitek et al., 2021). However, securing approval from local governments to place parcel lockers in public

spaces requires justification of their public value. The latter is not as well understood as its economic value and there is a lack of understanding of how local governments make decisions on parcel locker placement in public spaces. Hence, our research question is: *How does local government evaluate placement requests for parcel lockers in public spaces?*

## 2 Evaluation framework

Parcel lockers are one form of collection and delivery points, where a customer can retrieve or return their parcel. Other forms include shop-in-shop locations and neighborhood hubs. Because parcel lockers are an unmanned solution—a customer uses a one-time password, barcode, or QR code to access the locker—they are always accessible and can be placed in public space. No previous studies examined parcel lockers mainly from a policy perspective (Olsson et al., 2019). Instead, most studies take the perspective of the last-mile delivery service provider. Nonetheless, those studies provide insights that can be relevant for public decisionmakers in evaluating placement requests for parcel lockers in public spaces. Below, we discuss those factors that may play a role in this decision making.

There is ongoing debate about the ability of parcel lockers to reduce harmful **emissions**. From the perspective of the last-mile delivery service provider, including parcel lockers in delivery networks enable more efficient delivery routes (Enthoven et al., 2020) and could thus reduce emissions from delivery vehicles. Parcel lockers can also reduce the rate of failed deliveries (Mangiaracina et al., 2019) and vehicle idle time—significant drivers of harmful emissions in urban delivery routes (Figliozzi et al., 2020). Looking at the last-mile delivery system more generally, it is likely that the emission reduction of the delivery vehicle is offset by the mode choice of customers traveling to the parcel locker (Niemeijer & Buijs, 2023). Their study of over 50,000 customer trips show that the mode choice is influenced strongly by distance—if the length of the trip to a parcel locker is more than 400 meters, more than 10% of customers take the car and may thereby collectively emit more carbon than the delivery vehicle saved.

Last-mile delivery vehicles have been subject to criticism. They congest narrow streets, are noisy, park on sidewalks, and are involved in accidents and unsafe driving behavior. Christie & Ward (2019) explored road safety of parcel delivery drivers and found they perceive strong pressure to drive fast due to piece-rate payment schemes, use distracting work apps in their delivery vehicle, are exhausted due to grueling work schedules, and speed to meet delivery targets. These factors have a direct relationship with vehicle use. Shorter route length, fewer failed deliveries, and shorter stop times may decrease delivery **vehicle nuisances**.

**Parcel locker** may also create new **nuisances** themselves. For instance, they will likely lead to increased vehicle movements and parking near the locker—both of delivery vehicles and of customers using their car to travel to the parcel locker. This may be undesirable if driving space and parking opportunities are limited. Customers may feel unsafe using lockers, as they worry about potential criminal activity (Lachapelle et al., 2018). Therefore, the location decision should include consideration for perceived safety, for example, by locating parcel lockers in open areas behind shopping centers, lockers facing away from the street obscuring potential assailants, lockers with only a single exit opportunity, and so on.

Another reason to consider parcel locker placement is that it may meet **customer preferences**. Compared to unattended home deliveries—which may lead to negative feelings about security—some customers favor parcel locker delivery (Merkert et al., 2022). Generally, most customers still prefer home delivery though, but this may shift towards self-collection if there is a monetary incentive to do so compared to home delivery (Buldeo Rai et al., 2019).

Parcel lockers are often perceived as innovative, or as a driver for further **innovation** towards sustainable last-mile delivery. A parcel locker design with a fixed locker bank is implemented most widely, but there is no standard design yet. Faugère & Montreuil (2020) explore the option of modular locker towers within a locker bank while others contemplate mobile parcel lockers (Schwerdfeger & Boysen, 2020). Instead of requiring a permanent position in public spaces, mobile parcel lockers would require multiple locations where they can park for a certain period. They could be combined with cargobike logistics or play a role in optimizing crowd shipping (Gatta et al., 2019). These developments also explain why parcel lockers are a potential driver for innovation.

Lastly, parcel lockers could pull economic activity toward nearby stores. Early research on parcel lockers found that a quarter of consumers using a parcel locker also purchase something at a nearby store whilst retrieving or returning a parcel (Weltevreden, 2008). Not much research has been performed on this **pull effect** since.

A review of the academic literature on parcel lockers—and collection and delivery points more broadly—reveals a list of six factors that public decisionmakers may consider when they evaluate placement requests for parcel lockers in public spaces: emissions, nuisances of the delivery vehicle, nuisances at a locker location, customer preferences, innovation, and the pull effect of parcel lockers.

### 3 Methodology

Our methodology consists of two different stages, namely a series of semi-structured interviews at Dutch local governments followed by a workshop and multiple case study.

#### 3.1 Semi-structured interviews

We first conducted semi-structured interviews with decisionmakers in local government. We aimed to capture a variety of policy approaches used in evaluating requests for parcel locker placement by selecting cities with different characteristics. For example, we expected different results across cities because some have no parcel lockers in public space yet, whilst others have over fifteen. We also expected different results because some cities have more public space available than others due to different spatial development. Specifically, older cities often have less public space available as streets were not designed with cars and trucks in mind.

In total, we conducted 12 interviews across different cities in the Netherlands (see Figure 1 for the geographical spread of the cities). The interviews lasted 45 minutes on average, ranging from 37 to 68 minutes. During these interviews, we spoke to 14 public decisionmakers knowledgeable about parcel locker location issues—two interviews included two interviewees from the same city. The decisionmakers were mostly policy advisors with a focus on mobility, freight transport, public space, air quality, retail and leisure, or sustainability. Before the interview, all participants consented to be recorded. Afterward, they were informed how their data would be used (Turner, 2010). Alongside a transcript, interview data was categorized using structured meeting notes. These meeting notes aid construct validity (Karlsson, 2016; Yin, 1994) in the same way a coding scheme would whilst also allowing straightforward post-interview verification by the interviewee. In fact, several interviewees reached out to develop the meeting notes with data that had not come up in the initial interview.

Interview questions were designed to be neutral, clear, and open-ended, aiding reliability (Yin, 1994). In general, the interview consisted of introductory questions, an open discussion about parcel locker placement requests, focused questions aimed at weighing the six factors that public decisionmakers may consider when they evaluate placement requests, and some

concluding questions. For weighing the six factors, we adopted a point allocation method from multi-criteria decision making (MCDM) research, specifically by letting interviewees divide 100 points across the six factors (Bottomley et al., 2000; Mukhametzyanov, 2021). MCDM methods have been used previously in transport policy research as reviewed by Gohari et al. (2022). Our point allocation method is easy to understand for interviewees and forces them to consider trade-offs in the relative importance across all six factors (Zardari et al., 2015). The other elements of the interview were aimed at elaborating on how the points were allocated and how the city deals with requests for parcel locker placement generally.



*Figure 1: Geographical dispersion of local governments in this study*

Our analysis of the interview data began by identifying similarities in the results of the point allocation method. We then employed an iterative process to uncover different policy approaches by examining the point allocation results, meeting notes, and quote comparisons from interview transcripts. During the interviews, some participants shared internal guidelines for evaluating requests to place objects in public space, allowing us to compare their statements with their written guidelines. Additionally, we reviewed long-term spatial planning visions published by some cities, which confirmed our understanding of their commitment to reducing vehicle movements. To further support our findings, we utilized maps of last-mile delivery service providers to verify the presence of parcel lockers in public space, and to gauge potential issues related to their location. Through this approach, we obtained preliminary insights into the policy approaches governing the placement of parcel lockers in public spaces.

### **3.2 Workshop and multiple case study**

After completing the semi-structured interviews, we presented the results at a workshop for cities participating in the EU Horizon 2020 project ULaaDS. This workshop was attended by public decisionmakers from cities across Europe. The workshop provided a valuable platform to examine the different policy approaches and their implications.

## **4 Ranking of factors**

First, we present the results of the semi-structured interviews. Specifically, Table 1 shows the outcomes of the point allocation method. These illustrate in broad strokes that delivery vehicle nuisances are an important factor for local decisionmakers when considering parcel locker placement. Table 1 suggests that anticipated reductions in delivery vehicle nuisances are weighed against any new nuisances that may be created at the locker location—another factor with a generally high importance. Generally, innovation and the pull effect receive little attention. Emissions and customer preferences receive mixed scores, suggesting they are important factors in some cities, but not in others.

Table 1: Results of the point allocation

City	Emissions	Nuisances by vehicle	Nuisances at locker	Customer preferences	Innovation	Pull effect
City A	25	10	25	25	10	5
City B	10	40	30	10	0	10
City C	20	25	10	15	10	20
City D	35	35	15	15	0	0
City E	21	30	21	11	6	11
City F	25	30	10	20	5	10
City G	0	20	30	20	15	15
City H_1	30	30	30	0	10	0
City H_2	20	20	20	20	20	0
City J	0	60	25	5	5	5
City K	33	34	33	0	0	0
City L_1	10	40	10	30	5	5
City L_2	30	20	20	30	0	0
City M	0	0	100	0	0	0

Prior research suggests that parcel locker networks can reduce the number of failed deliveries (Deutsch & Golany, 2018), reduce distance driven by delivery vehicles (Enthoven et al., 2020; Iwan et al., 2016), and thereby reduce the number of delivery vehicles (Deutsch & Golany, 2018). By contrast, several local decisionmakers see parcel lockers as a useful solution when they would ban delivery vehicles in specific streets: *“There should be no vehicles at all in the public space of City H. They are tacky. At this point, we feel City H should no longer be gray, but green and livable instead. [...] With parcel lockers we will not remove delivery vehicles from the municipality fully, but we can get them out of the capillaries of neighborhoods. They no longer need to go through every street of a neighborhood”* (City H\_1). Similarly, City A is developing a new neighborhood where no cars may enter at all. This is a novel insight on how parcel lockers fit into policy approaches of local governments.

All interviewees deem nuisances at the locker location as a primary constraint for placement in public spaces. For some interviewees, it is clear that they will almost always prohibit placement of parcel lockers in public spaces as they perceive too high of an impact of parcel lockers on public spaces. *“The chance of a parcel locker passing our decision framework is very small. This is a guiding principle, as there is so much demand for use of public space”* (City B). Also: *“We have a vision on spatial structure in City H. Therein we named the content for all public space. ... Other than functional street furniture such as a bike rack or a bench we do not want to offer any objects in public space. ... We do not want parcel lockers in public space at all”* (City H\_1). Other interviewees pose that reduced vehicle movements may not be achieved if parcel locker placement is obstructed significantly: *“Not wanting to work with them [parcel*

*lockers]. I would like to flip it. Everything. Why would you not want to work with them? This is a fundamentally different vision, right? A different point of reference” (City M). The degree of restrictiveness for placing parcel lockers in public spaces is offset against the perceived effectiveness of parcel lockers in reducing vehicle movements—and we observed fundamental differences between decisionmakers in that regard during our interviews.*

## 5 Policy approaches

Our study also identified two distinct approaches that decisionmakers in local governments take when facing requests for parcel locker placement in public spaces. The first approach is a *reactive* one, where requests for parcel lockers are addressed on a case-by-case basis. Delivery companies request a location that is optimal for their business, and local government either approves or denies the request. The second approach is *proactive*, where the local government actively participates in location decisions for parcel locker placement in public spaces.

### 5.1 Reactive policy approach

Many cities adopt a reactive policy approach. The common denominator in this policy approach is that requests for parcel locker placement in public spaces are generally considered case by case. Differences emerge depending on the attitude of the local government towards parcel locker placement in public spaces, which could be more negative—resulting in a de facto restrictive policy—or more positive, leading to a generally permissive policy.

#### 5.1.1 De facto restrictive

The de facto restrictive policy was identified most saliently in City J. Their approach is based mainly on a fear of many locker providers conglomerating at the same location: *“Our urban planner would already be worried about a single locker. Say that a locker is placed in the city center at the central station, a place where everyone comes. Suddenly, four more parcel companies want to have their parcel locker there. [...] Maybe we should not do it, if the alternative is getting four parcel lockers. (City J)”*. City J perceives very little opportunities for parcel lockers to be placed in the city center: *“Especially in the inner city, parcel locker placement would not result from their ideal location based on science but on the very few locations where they would even fit. [...] It’s a consistent point of attention, how can you fit things nicely.”*. Finally, City J believes that postal companies have plentiful opportunities in private space, and hence sees little need for parcel lockers in public spaces: *“Why should a delivery company get public space? Currently, postal companies manage inside specific third-party stores. ... It will always be a question, should we even consider parcel lockers in public space?”*.

Following the initial interview, City J developed a decision-making framework based on the de facto restrictive approach. This framework helps guides the response to placement requests by parcel companies. Furthermore, the framework allows any locker provider to easily familiarize themselves with the municipality stance on parcel lockers in public space. The framework of City J is based on two guiding principles. First, the distance to existing parcel points, as this guides the mode of transport used by consumers (c.f., Niemeijer & Buijs, 2023). Second, the use of public space should only be considered if no private space is available. Any building destined for commercial use—excluding restaurants and pubs—is classified as available private space is. Residential buildings such as flats or apartment blocks are not considered as the commercial exploitation by locker providers is currently too limited.

### 5.1.2 Generally permissive

The generally permissive policy was found most strongly in the semi-structured interview with City M, which was approached by a major Dutch parcel delivery company with a request for parcel lockers in public spaces. The local government created a decision framework to assess placement requests. Within this framework, City L assumes that parcel lockers generally have a positive effect and that parcel delivery companies are best suited to determine optimal parcel locker locations. To reduce decision making time, the municipality now considers itself solely an auditor of placement requests.

In our semi-structured interviews, policy advisors often noted a concern of many parcel lockers suddenly appearing next to each other in public spaces if they adopt a permissive approach. From City M, we learn that this concern is not necessarily valid: *“They used those arguments: Well, you will get 25 kinds of parcel lockers next to each other. It will look horrible. Guys, I don’t see that happening yet. If the problem were to arise, we would do something about it. However, it is not something we will regulate beforehand as it will kill the entire concept as well”* (City M).

Another lesson learned is that by simply starting to permit parcel lockers in public spaces local government will learn how to fill in a decision framework along its own wants and needs: *“Then they placed the lockers. This caused quite a stir. Suddenly everyone felt they needed an official permit. So, we started that trajectory. Then, the environmental committee voiced their opinion. The locker was too big, there was too much advertising. I said, do you not want the lockers? This was not the case, they just had certain requests. All parts of the municipality had to have their say. You simply have to endure that and make some changes to the existing parcel lockers. [...] We added all of that into a procedure. What does the municipality find important? We had done this previously, but now we made it official.”* (City M).

## 5.2 Pro-active evaluation

At the time of the semi-structured interviews, none of the cities we studied had a pro-active policy approach, where the evaluation of parcel locker placement requests in public spaces is an integral part of a broader sustainable urban logistics plan. During the workshop, the city of Mechelen and last-mile delivery service provider bpost discussed their Ecozone approach, now rolled out to six cities across Flanders, Belgium. The city of Mechelen took a pro-active stance and published a public tender for parcel lockers in public spaces in 2018, and again in 2021.

After awarding the contract to bpost, the city of Mechelen and bpost together determined the ideal number and location of parcel lockers in public spaces. This involved coordination among different departments within local government and with bpost. The coordination efforts resulted in a network with 57 collection and delivery points within the inner city of Mechelen, including eight manned pick-up points and 49 parcel locker locations. The Ecozone not only involves developing the network of collection and delivery points, but also the greening of the fleet of delivery vehicles and a microhub to complete the network. The parcel lockers and home addresses in the inner city of Mechelen are supplied by cargo bikes. Due to the dense network of parcel lockers, 81% of customers traveled less than 500 meter to collect their parcel—resulting in a minimal use of car travel. 85% of customers picked up their parcel by bike or on foot. Overall, the Ecozone reduced total carbon emissions by 97%: 122.4 ton was avoided because of bpost using zero-emission vehicles and another 0.6 ton was avoided by changing customer travel behavior when going from and to a collection and delivery point (VUB Mobi, 2021).



## 6 Conclusions and discussion

In this paper, we discuss policy approaches for parcel lockers in public space. If last-mile delivery service providers want to locate parcel lockers in public spaces, they require the approval from local government. When faced with a request for parcel locker placement in public spaces, decisionmakers at local government will consider the public value parcel lockers may bring. Our study shows that carbon emissions, locker location nuisances, delivery vehicle nuisances, customer preferences, innovation, and the potential pull effect on nearby commercial establishments are elements that can be considered. The results of 12 semi-structured interviews and a workshop with public decisionmakers in cities across the Netherlands and Europe provide a clear picture of how decisionmakers weigh these elements when considering a request for parcel locker placement in public space. Interestingly, the study reveals decisionmakers at local governments mostly see parcel lockers as a solution to address delivery vehicle nuisances, whereas the academic literature primarily views parcel lockers as a means to reduce carbon emissions and improve customer service through improved consolidation and reduced failed deliveries.

Local governments either adopt a reactive or proactive approach when facing requests for parcel locker placement in public spaces. Many cities take a reactive approach, mostly addressing requests for parcel locker placement on a case-by-case basis. Under this approach, delivery companies consider what would be a suitable location for their operations—considering the economic and customer service benefits of parcel locker—and file a request for placement at the local government. If the location is not suitable from the perspective of the local government, for example because it would attract unwanted vehicle movements, the request is denied, and the delivery company could file a request for another location. This back and forth commonly results in few—if any—parcel lockers in public spaces. Even in these cities, though, parcel lockers tend to pop up on private property, but only where they make economic sense for the delivery companies. This means that the negative externalities associated with these locations, such as nuisances at the locker location or increased emissions from customers picking up their parcels by car, are beyond the control of the local government.

A few cities around Europe have taken a more proactive approach, for example, by publishing a public tender for operating a network of parcel locker locations in the city. While a proactive approach requires extensive coordination across different departments within local government and communication with potential delivery companies, such an approach can result in more positive outcomes of parcel locker placement in public spaces.

### Acknowledgements

The ULaaDS project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 861833. ULaaDS is a project under the CIVITAS Initiative.

### References

- Bottomley, P.A., Doyle, J.R., Green, R.H. (2000): Testing the Reliability of Weight Elicitation Methods: Direct Rating versus Point Allocation. *Journal of Marketing Research*, v7, no4, 508-513.
- Buldeo Rai, H., Verlinde, S., Macharis, C. (2019): City logistics in an omnichannel environment. The case of Brussels. *Case Studies on Transport Policy*, v7, no2, 310-317.
- Deutsch, Y., Golany, B. (2018): A parcel locker network as a solution to the logistics last mile problem. *International Journal of Production Research*, v56, no1-2, 251-261.
- Christie, N., Ward, H. (2019): The health and safety risks for people who drive for work in the gig economy. *Journal of Transport & Health*, v13, 115-127.

- Enthoven, D., Jargalsaikhan, B., Roodbergen, K., uit het Broek, M., Schrotenboer, A. (2020): The two-echelon vehicle routing problem with covering options: City logistics with cargo bikes and parcel lockers. *Computers and Operations Research*: v118, 104919.
- Faugère, L., Montreuil, B. (2020): Smart locker bank design optimization for urban omnichannel logistics: Assessing monolithic vs. modular configurations. *Computers and Industrial Engineering*, v139, 105544.
- Figliozzi, M., Saenz, J., Faulin, J. (2020): Minimization of urban freight distribution lifecycle CO<sub>2</sub>e emissions: Results from an optimization model and a real-world case study. *Transport Policy*, v86, 60-68.
- Gatta, V., Marcucci, E., Nigro, M., Patella, S. M., Serafini, S. (2019): Public transport-based crowdshipping for sustainable city logistics: Assessing economic and environmental impacts. *Sustainability*, v11, no1, 145.
- Gohari, A., Ahmad, A.B., Balasbaneh, A.T., Gohari, A., Hasan, R., Sholagberu, A.T. (2022): Significance of intermodal freight modal choice criteria: MCDM-based decision support models and SP-based modal shift policies. *Transport Policy*, v121, 46-60.
- Karlsson, C. (2016): *Research Methods for Operations Management*. Routledge: New York.
- Lachapelle, U., Burke, M., Brotherton, A., Leung, A. (2018): Parcel locker systems in a car dominant city: location, characterisation and potential impacts on city planning and consumer travel access. *Journal of Transport Geography*, v71, 1-14.
- Mangiaracina, R., Perego, A., Seghezzi, A., Tumino, A. (2019): Innovative solutions to increase last-mile delivery efficiency in b2c e-commerce: a literature review. *International Journal of Physical Distribution & Logistics Management*, v49, no9, 901-920.
- Merkert, R., Bliemer, M., Fayyaz, M. (2022): Consumer preferences for innovative and traditional last-mile parcel delivery. *International Journal of Physical Distribution & Logistics Management*, v52, no3, 261-284.
- Mukhametzyanov, I. (2021): Specific character of objective methods for determining weights of criteria in MCDM problems: Entropy, CRITIC, SD. *Decision Making: Applications in Management and Engineering*, v4, no2, 76-105.
- Niemeijer, R., Buijs, P. (2023): A Greener Last Mile: Reviewing the Carbon Emission Impact of Pickup Points in Last-Mile Parcel Delivery. Available at SSRN: <https://ssrn.com/abstract=4169737>.
- Orenstein, I., Raviv, T., Sadan, E. (2019): Flexible parcel delivery to automated parcel lockers: models, solution methods and analysis. *EURO Journal on Transportation and Logistics*, v8, no5, 683-711.
- Schwerdfeger, S., Boysen, N. (2020): Optimizing the changing locations of mobile parcel lockers in last-mile distribution. *European Journal of Operational Research*, v285, no3, 1077-1094.
- Sitek, P., Wikarek, J. (2019): Capacitated vehicle routing problem with pick-up and alternative delivery (CVRPPAD): model and implementation using hybrid approach. *Annals of Operations Research*, v273, no1-2, 257-277.
- Turner, D.W. (2010): Qualitative interview design: a practical guide for novice investigators. *The Qualitative Report*, v15, no3, 754.
- VUB Mobi (2021): <https://press.bpost.be/successful-mechelen-ecozone-pilot-project-bpost-delivers-letters-and-parcels-emission-free>
- Weltevreden, J. (2008): B2c e-commerce logistics: The rise of collection-and-delivery points in the Netherlands. *International Journal of Retail and Distribution Management*, v36, no8, 638-660.
- Yin, R. (1994): *Case Study Research: Design and Methods*. Beverly Hills, CA: Sage Publishing.
- Zardari, N. H., Ahmed, K., Shirazi, S. M., & Yusop, Z. B. (2015): *Weighting methods and their effects on multi-criteria decision making model outcomes in water resources management*. Springer.