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An Exploratory research on Urban Data Platform business and operational model

—Achieving circular economy of data with supply chain mechanism

Master's Thesis in Information Systems
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ABSTRACT

Cities are opening available governmental data to public as data is considered as the key to foster social, economic and environmental sustainability in a smart city. Publishing static yet diverse municipal data from different database systems into one place requires establishing an urban data platform for everyone's use. However there has been a lack of research in understanding urban data platform and a standard for its operational model. Because of this research gap and the presence of supply and demand of data, this thesis paper has conducted an exploratory research on urban data platform and conceptualized operational model thereof using supply chain mechanism, which has been tested against three real life urban data platforms. In addition, it has investigated platform business model to evaluate urban data platforms operational orientation. Finally, the paper proposes an extension of the concept model that creates circular economy of data.

The majority of the findings of the research support the proposed concept model of urban data platform operation. Moreover, new insight that is urban data platform business model is similar to multisided platform business model is also discovered.

The importance of this research lies to practitioners both in public and private sector and to researchers in academia. For decision makers, the paper has drawn systematic, logical and objective-focused operational concept so that to experiment and improve data platform operation in practice. In addition, it also recommends an intelligent approach to exploit circular economy of data throughout urban data ecosystem / urban dynamics that would serve both city services internally and boost innovation and economic growth externally. For researchers the paper sets lay out for future research directions within and beyond the field of information systems and social science.

Keywords: Urban data platforms, Platform as a business model, Supply chain management, Smart city, multisided platform business model, urban data platform operation, circular economy of data.

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1 INTRODUCTION

1.1 Context

The natural biasness of people in moving from small provinces to bigger municipalities have always been observed due to greater development opportunities in all sectors of life and the concurrent evolution in information and communication technology. This has led to massive urbanization. But with greater changes there comes abrupt positive and negative consequences. Presence of cultural diversity, potential career development, future boost in economy are some good examples of what we can expect from such changes. Contrarily high concentrated inhabitants will escalate number of traffics on street that will result in increased number of carbon emission, and subsequently will affect residents' health and mental condition, and environment as well. This tipping point birth the "smart city" concept to facilitate improvement and sustain health and environment. (Cocchia, 2014)

According to Sarah Wray (2016), one of the differentiating characteristics of a smart city is the city being guided by data. As cities are continuously generating large sets of data, publishing data would harbor innovation, new business opportunities and enhance city operation efficiency. The publication of data, either free or monetized helps a smart city to develop its pre-existing and potential services and applications (Liu, Heller & Nielsen, 2017). With the help of big data technology, published data can be converted into applicative intelligence to use in businesses. However, this can only be achieved by establishing an intermediary-essentially called big data platform. (Cheng, Longo, Cirillo, Bauer & Kovacs, 2015)

The job of a data platform is to make concealed data disclosed and connected to a bigger data network (Pettit et al., 2017, cited in Barns, 2018). Publicly available data are so much decentralized that putting together all consumable and reusable data for smart city application has been considered as the goal of data platform (Vieira & Alvaro, 2018). For a data platform to work, both technical and organizational model must be set up. Multi various data source systems should be allowed to connect to the technical layer of the platform. At the same time, having an organizational process guideline will secure

maintaining the data insourcing, delivery and storing into the platform. ("Data Platforms | Center for Smart Cities", n.d.)

1.2 Research gap and motivation

Above analysis on requiring a data platform spurs several convictions.

Firstly, when I searched with words “city/urban data platform” in Google scholar to look for past academic materials on chosen topic, very limited number of academic works have been found that directly links to urban data platform and its modelling. Also, most of the scholarly work resulted and related to urban data platform connect to only sensor and IOT based data (dynamic data) platform rather than available public data owned by many public agencies (domains such as transport, education, social service, infrastructure, population, environment etc.) within the city. Therefore, academic knowledge regarding the back-end operational model of a city data platform specially emphasizing on currently available public data (static data) has not been explored by researchers in academia.

Secondly, other than academic work, searching with keywords such as “data platform” and “data management platform” produces results of data platform applications that are currently commercially offered by many information and technology companies. It presents a gap of understanding in distinguishing urban/city data platform from those of commercial data platforms. Moreover, at present (urban) “data platform” only means commercial data platforms. Due to this, existence of open data platforms initiating from municipal end is being overlooked by citizens (users). Bringing open data platforms into the mainstream data platforms is also another intrinsic agenda of my work.

Thirdly, provisioning diverse data sources into data platform system means establishing technical infrastructure capability to integrate diverse database systems, that is referred as “interoperability”, is one of the key challenges to develop one platform for all data sources. Consider Chicago’s smart data platform that collects millions of data in unstructured format every day from separate systems, which makes it difficult for public authorities to make data-based decisions ("Chicago’s SmartData Platform", 2014).

Finally, Smart cities technology center of IBM research has studied on a platform called “QuerioCity”, where they introduced two roles in the data platform: data publisher and

data consumer. The first type of character, using software tools, tries to print, tie and safeguard data that the platform publishes; The second character, presumably, explore related data queries. (Lopez et al., 2012) Lopez et al. work on queriocity and emphasis on role, has given this paper a new perspective of thinking, which entails supply and demand management of data.

Therefore, I decided to set objective to conduct exploratory research on urban data platform and to build and validate a standard operational model using the key practices of supply chain management. In addition, the research has given significant effort in gaining new insights on urban data platform business model.

1.3 Research Objective

As I have shortly acquainted the current absence of knowledge in urban data platform in academia and an operational model thereof in practice, thus research objective of this paper is to execute an exploratory research on urban data platform, supply chain management and multisided platform business model. One of the objectives for explorative study is to observe the supply and demand influence in urban data platform operation.

I will also build an operational concept model for urban data platform using supply and demand analogy thereafter. The concept model will demonstrate my creative thinking of connecting urban data platform with supply chain management. It will include several supply chain key practices. So, another objective of the paper would be to test the model against three urban data platforms and justify chosen supply chain key practices in data platform operational model.

In addition, as my concept model will consider eco-system design approach, so through studying multisided platform business model and testing the model, I would identify new insights on urban data platforms business model. Based on the results and insights generated against testing, I will provide possible managerial implications and subjective suggestions.

1.4 Research Questions

In the light of research objective delineated earlier, I have developed below research questions:

- Are supply chain mechanisms observed in urban data platform operational management?
- What are the key supply chain mechanisms applied in the urban data platform operation?
- Does urban data platform business model behave same as multisided platform business model?

1.5 Research Methodology

This research paper exists due to lack of understanding of urban data platform and its operating model in both academia and industry, and to learn urban data platforms business model. Exploratory research design is chosen as to understand three fundamentally different domains: urban data platform, platform business model and supply chain management. In addition to that, limited or no previous qualitative researches have been done on urban data platform, concerning smart city initiatives and objectives, for which exploratory research is deemed suitable to set initial research.

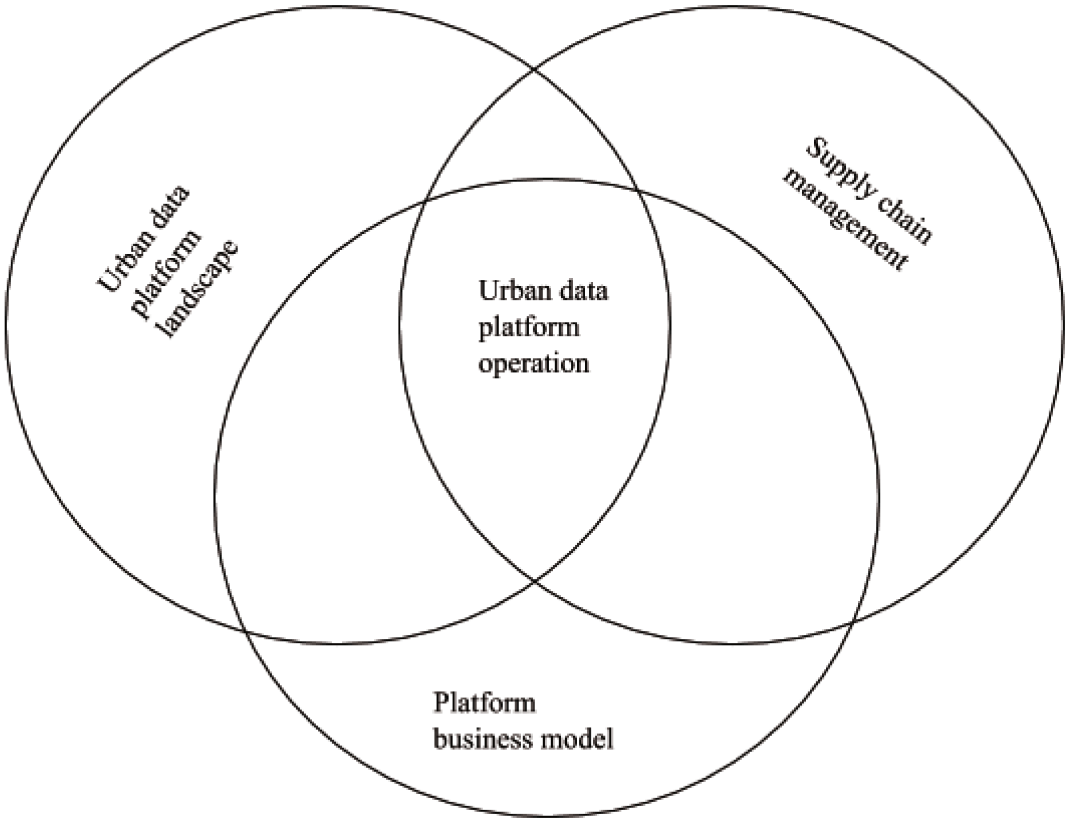

Figure 1 Representation of urban data platform operation in research scope

inductive reasoning research method has been used in designing the complete research. Since I conducted an exploratory research, commencing on the basis of predefined theory was impossible. Therefore, first I have created a concept model using literature analysis instead of hypothesis; afterwards through inductive reasoning the model had been put to test, observe, develop new insights and ultimately modify the model.

Literature review method

I have chosen two types of literature review methods on the different domains. *Systematic literature review* was chosen to review scholarly articles, journals and electronic academic books in three different domains: urban data platform, platform business model and supply chain management. All the reviewed materials were qualitative in nature and therefore non-statistical meta-synthesis technique (which is consistent with inductive reasoning research approach, mentioned later) has been used to interpret the literatures. Scholarly articles are sourced from “sciencedirect”, “proquest ebook central”, “emerald insight”, “Google scholar” “Åbo Akademi University library”, “University of Turku library”. Search key words used were “urban data platform”, “city data platform”, “Smart

city", "platform as a business", "platform business model", "supply chain management", "procurement and logistics". The other literature review was useful during concept modelling mentioned below.

concept model and interview question development

A conceptual model that connects both data platform and supply chain, is developed on the basis of learning from literature reviews. The *integrative literature review* method was taken into consideration while developing the concept model (chapter 2 section 4).

Since the model represents two (urban data platform and supply chain management) among three domains, so interview questions were designed using the model as standard in a way so that 1st and 2nd research questions can be answered. To address the 3rd research question, key critical variables from literature "platform as a business model" are identified. Through connecting variables, I have formed "constructs" that include both dependent and independent variables. Each construct demonstrates relation between variables and lead to assumptions of the context under study. Variable development and structuring construct were done only for generating questions of business modelling aspect in order to find results of 3rd research question. Thus 33 interview questions aiming to answer research questions were produced. (see index)

Data Collection method

Based on the research design chosen earlier, qualitative research method was selected for data collection and analysis. Both primary and secondary data have been collected.

The project research was affiliated with city of Turku. As I expressed my interest in conducting research on urban/city data platform in smart city project, so the strategy and development department of city of Turku (Turun Kaupunki in Finnish) had agreed to support the research from February till May 2018. Thus, I worked as a project trainee during the period with city of Turku. In smart city scope, city of Turku is developing their urban data platform named as "Turku data office". There are three personnel "project director", "city manager" and "development manager", whom are associated with "smart and wise Turku" project and are responsible for developing the data platform "Turku data office". Therefore, I interviewed them using in-depth face to face interview method and open-ended questions. However, during the aforementioned work duration (February till May 2018), several formal interviews and discussion sessions were also held on bi-

weekly basis and answers or views were stored for writing their project descriptions in this paper (chapter 1 section 1) and transcribing the results (see result chapter). Interview was taken at one occasion with three respondents altogether. This is how interviewees were selected and primary data on one urban data platform "Turku data office" was collected.

On the other hand, secondary data was collected on two other urban data platforms: "Amsterdam city data" and "Denmark open data". To interview concern persons in each of these two urban data portal, I sent a request letter with a statement of purpose through email. However, due to their lack of their availability, conduction of interview was dropped, and content and discourse analysis method were chosen to extract data against the questions. In case of Amsterdam, when contacted, management team of municipal of Amsterdam shared related publications on their data portal in Github. The given web address of the page is https://amsterdam.github.io/ . Information and content available in this page was analysed under research context and against the earlier developed questions and thus secondary data on Amsterdam municipals data platform was collected. Contrarily, due to failure of response from Denmark open data platform authority, content from Denmark open data (http://www.opendata.dk/) and data portal (https://portal.opendata.dk/) were taken as materials to collect required data. In both case of Amsterdam and Denmark data portal, information was collected pertaining to the open-ended questions developed earlier. Thus, through reviewing public online documents, question answers were filled in and secondary data on two urban data platforms were compiled together.

Data analysis

To analyse data, I have used both narrative analysis, and content and discourse analysis method on primary and secondary data respectively. First, using selective coding style, theme of investigating context was identified (codes are presented in result chapter inside table first column named as operational functionalities/factors). Next, to locate theme or pattern, repetition of key words or phrases were checked throughout respondent's answers. Also, I have discussed my findings and results against each codes/theme identified in this stage (Chapter 4). Both primary and secondary data are compared to find out commonalities and differences. Finally, I have identified and discussed new insights and findings to connect them to research objective in the discussion chapter.

1.6 Related work

Although concrete academic works on an urban data platform leading to smart city has not been found at an expected level, however, several studies are found that somewhat closely or distantly connected to this field of study.

Considering urban city planning, individual city entity's decision making, and their operation and databases being disintegrated from each other, Psyllidis, Bozzon, Bocconi & Titos Bolivar (2015) had conducted an empirical study that develops a novel web-based platform system that can source data from social media and IOT sensor, and individual city departments databases, and subsequently interpret the data through visualization. The proposed system incorporates data science method, semantic integration techniques and crowdsourcing. Targeted at stakeholders such as urban planners, the study aims to help understand the social urban dynamics. The study methodology explains that the system can take contents from social media, mobile phone data, location-based data and open municipal demographic data without clarifying the level (aggregated or personal) of data being captured, which however raises the privacy breach issues. Nevertheless, the system's approach to integrate different data providers (independent city domains) into one to source data is a positive one, which would be fulfilled by arranging a knowledge representation model inside the system. With data exploration, users can investigate customized (map/demography/social media dynamics) visualized data and store it offline for further usage later on. The research work then has evaluated the validity of the platform in three real world use cases. While the idea of adding up the cross functional city operations into one is appreciating, micro ideas of including "crowdsourcing" sub process is explained vaguely and can create mass data conflict. Moreover, the possible pitfalls in mining consumer data has not been considered. In addition, the prospect for other actors in the platform ecosystem is also missing here.

Another work, which is more related to this paper, is found in the qualitative research paper "Data governance in the sustainable smart city" where authors studied project called Triangulum consisting of three European cities in order to seek the method to actualize the governance of data for the purpose of sustainable urban development. The paper questioned the limited understanding and unsubstantiated practice of sustainability and smart city initiatives rhetoric. The authors have identified that the smart governance driven by citizen participation and data and ICT are the core of sustainable urban

development. The paper has built a conceptual framework to operate data based on past literature and conducted a collaborative stakeholder survey among three cities. Study on data governance is done by asking "what", "who" and "why" questions to participants and was analyzed qualitatively. The objective of this survey is to gather knowledge pertaining to creation of data, capturing, storing and maintenance of data, and sharing and extended future use of data. Furthermore, actors' involvement process, needs and participation extent in data monitoring and collection were also central conversation of the survey. The project survey considered the barriers and challenges connected in performing data governance activities. Finally, it gave ample importance on incorporating sustainable process development in data development during and beyond the project. The paper deduced that in order to develop sustainable smart city development, a collaboration alongside government being the key player in sharing data, is needed under the criteria of data governance. Also, this study emphasizes that realizing the data governance will occur if bottom up approach is taken into consideration, meaning that identifying data needs and collection of data at micro instead of generic level. (Paskaleva et al., 2017)

1.7 Project description (Smart and Wise Turku)

This thesis research paper is supported by the city of Turku itself in an effort to promote Turku's approach to smart city "smart and wise Turku" and intent to generate circular economy of data. In this section, a brief project description, followed by Turku cities current data platform operating and business model have been presented.

Carbon neutrality, smart city, digitalization, socially, environmentally and economically sustainable city and its competitiveness- all these terms has inspired the Finnish city "Turku" (Åbo in Swedish) to initiate the project called "Smart and Wise Turku" on September 18, 2017. Opening up the governmental data is one of the key pillars for elevating Smart and Wise Turku project.

1.7.1 Urban Data platform: Turku data office

The digital data platform is the core element in establishing the circular economy of data for the City of Turku.

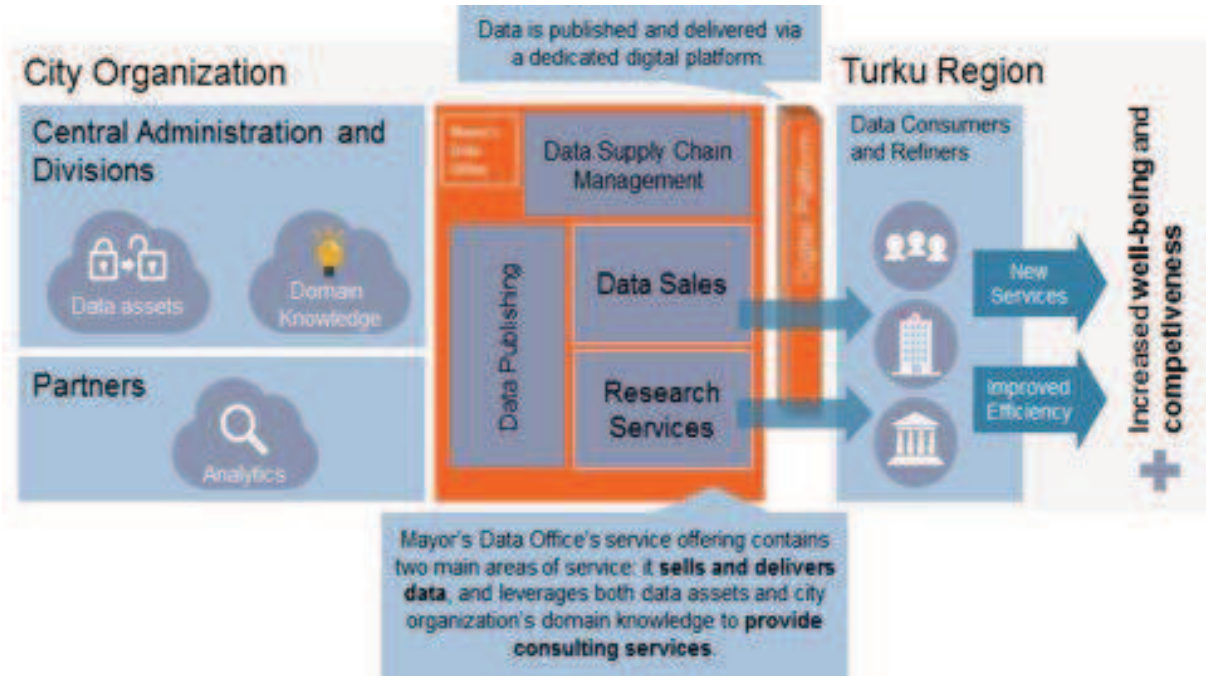

Figure 2 Turku data office operational model

So, the platform is the connection enabler among users and data and providers and refiners of data on demand. It can also be referred as a business platform. Digital platform can create a business environment since it will attract multiple actors whom would be able to exploit the data through the creative use of supply and demand of data and thus will create a business ecosystem. (Turun Kaupunki, 2018).

The vision of data platform complies with that of the vision of "Smart and Wise Turku" project as well. Data platform vision 2029 sets target to boost wellbeing and competitiveness in Turku region and to accomplish target of reducing CO2 emission within city of Turku (VTT Technical Research Centre of Finland Ltd, 2017). The digital data platform from city of Turku is referred to as Turku data office and is the owner of the platform and responsible for maintaining the transaction of data supply. Although the platform is owned by city of Turku, however, a private independent organization (as of this writing) will be supposedly in charge of the platforms operation in circulating data to the other users within the city. Moreover, the Turku data office works alongside the city organization to retrieve public data that are already available in city's database.

1.7.2 Turku Data Office business model

To understand the current operative model of data platform of City of Turku, business model canvas[1] has been used. Information was extracted from project manager and director of data platform along with city's internal documents.

Customer segments

Turku data office aims to provide data service to four sets of customer segments. Private citizens and non-profit organizations fall under one umbrella to whom the value will be unique. The offering to these group is the data platform itself and the value, it will create is open data, better services for citizens, collaborative new services and decision making.

The second customer bundle is business organizations. This segment is considered as the most important value creator for the platform's first two stages. The offering for business entities is the data platform and consultation service. The value is potential published data and internal business problem solvency for business development and open innovation. In addition, API access would be served as an offering so that it can be accessed and manipulated according to the needs of the business companies. Furthermore, the city's own domain experts, with platforms unique data capability, gives specific consultation services to companies.

The platform will also offer joint research projects with these research entities to develop the city and its inhabitants. As a result, the value for these actors will be research projects shared by the city, domain specific knowledge, data and the platform itself. The fourth and final group of customers is the city itself. The data platform, Turku data office, operates as an independent organization, and be a model to provide

[1] Business model canvas is a management tool for organizations, specifically for lean startups in order to help them in devising their current business model or innovating new business model. the concept of business model canvas tool was first introduced and proposed by Alexander Osterwalder.

resourceful consultation to different city organizations to improve each capability to serve the residents. The platform offers data to enable value of "data-driven decision making".

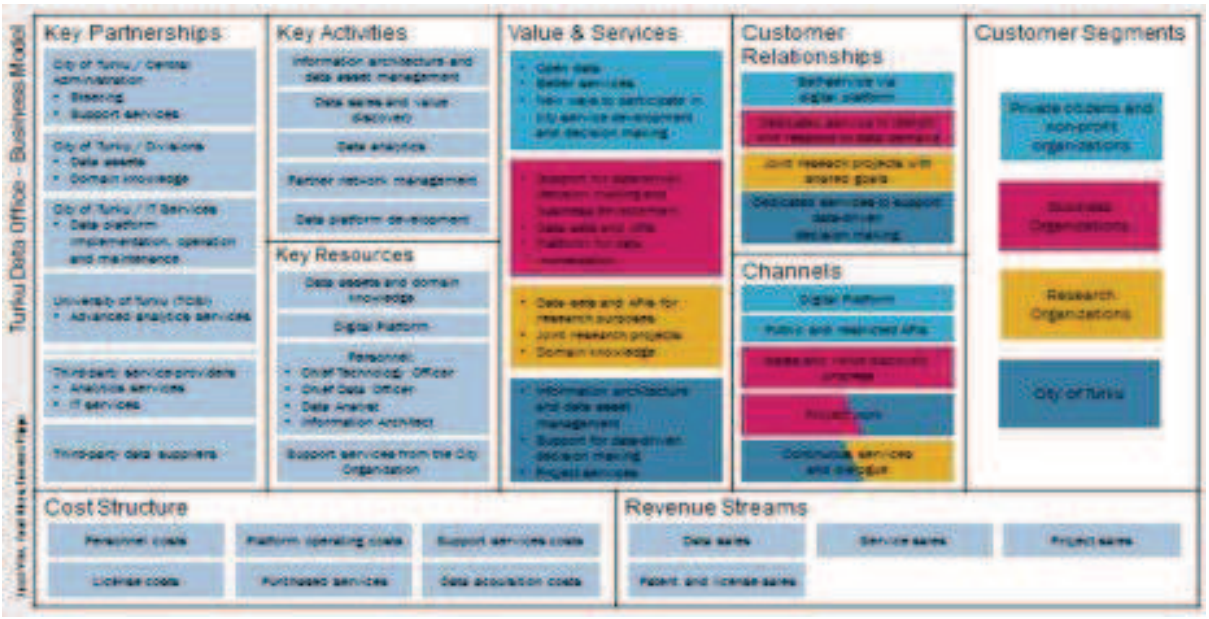

Figure 3 Business model CANVAS of Turku data office

Key partnerships

To resume consistent performance of the platform, it has partnered with multiple stakeholders. The central administration office of City of Turku, as a partner, supports and steer services to the platform whenever deemed necessary. Different divisions within the city of Turku are also in collaboration with the platform to supply domain data. Turku data office has also allied with IT service from city of Turku office in regard to establish the technical implementation, maintenance and operation of the platform. Turku data office has affiliated with University of Turku, which would provide data analytical service. Other than these, the platform is also in close contact with third party companies, which would cater IT and analytical services if the current partners are in deficit.

Customer relationship

citizens and non-profit users of Turku data office can access data API and download data via self-service from the platform. However, for business users, besides providing self-service for available data, datasets that are requested by companies are provided through the platform and can be accessed or downloaded using login credentials. The relationship with research organizations is more personal than automated since most of the services

given here are joint based projects, which require both parties' physical involvement in data analysis and seldom-electronic communication. Turku data office is going to maintain a combination of automated and personal service with other city organizations, where users from different domain would collect data from the platform by themselves and at the same time can leave request for further personal assistance when necessary. That being said the city platform initially plans to maintain customer relationship more offline than online during the first phase.

Channels

The digital portal, known as "Turku data office" would be the channel of data distribution primarily to all users. Public and restricted API will be the supplementary channel to provide access to datasets. Nevertheless, since the platform will also provide consultation service, the communication channel between participants would be electronic such as email and delivery of finished service can either be in personal or digital (document) form. Even though the data and the platform will eventually be used in the process, the ultimate delivery of the project service solution involves personal touch as medium. Similarly, for research organizations and other city organizations, the channel of delivery is personal continuous service and dialogue.

Key activities

Designing the information flow throughout the website, intranets to make the user experience transparent and convenient is one of the key tasks. Correspondingly managing the data assets and the continuous integration of databases between the website and source base is fundamental to data platforms capability. Therefore both "information architecture and data asset management" have been tagged as one of the key activities here. Turku data office will make continuous effort in communicating with business companies to identify the companies need and usage of data and how a value for both the platform and the companies can be generated from it. This activity has been referred to as "sales and value discovery process". Because of the consulting and project-based services the platform offers, Turku data office will conduct data analytics service based on demand. Turku data office, as the central part of urban data platform ecosystem, will execute some key initiatives such as providing network management guidelines on a regular basis to sustain this network in the long run.

Key resources

Turku data office comprises of technical, process and human resources. Technical resources include datasets as assets coming from different databases. The platform itself is another resource for Turku data office. Human resource includes domain experts and their knowledge on specific functionalities, key personnel such as chief technology officer, chief data officer, data analyst, information architect etc. Process resource includes support services from the city of Turku.

Cost structure

The cost structure has been divided into three divisions. There is a monthly cost of employing and maintaining personnel. This cost is being created due to having employed human resources mentioned earlier. Another set of costs are coming from operating the platform cost. It also includes data acquisition costs. There are many datasets that are beyond jurisdiction of the city of Turku at present; in such cases the city needs to buy the datasets from the private owner. Turku data office will buy analytical service from the university or others and thus a cost will generate. In relation to that while performing consulting services to companies, Turku data office will seek for additional IT/expertise advice support from third party companies, which in turn will create "support service cost". The overall maintenance and implementation of the platform will cause recurring operating cost. For example, Turku data office needs to equip itself with automated systems for internal and external communications, security and privacy system and other technical systems that help building the platform. Purchasing licenses of these systems will hatch another set of "licensing cost".

Revenue Streams

The basic profit will generate from data and service sales, since their primary goal is to monetize the datasets and consultation services. The pricing of the datasets would be same regardless of the user types. Turku data office has applied 'differential pricing' on a project solution service. The price will vary according the time allocation, and IT and expertise cost.

1.8 Structure of the paper

The rest of the paper goes as follows: in chapter 2, the paper has presented a comprehensive literature review on three different domains. Based on the review a conceptual model has been built in this chapter. Next, the chapter 3, contains results of testing based on the conceptual model. Chapter 4 discusses about the results and shows possible implications of results to readers. Through discussion, the paper has revisited the first model only to revise and affirm new improved model based on the results. Finally, the paper concludes by sharing authors recommendation, research limitations and future research scopes.

2 LITERATURE REVIEW

In this chapter, a detail background review on three domains has been presented. In the first two sections, the readers will get to know about urban/city data platform and its technicality. Note that the words “urban and city” were used interchangeably to make the paper consistent with past research. After that a section with platform business model literature review is presented. Business model Canvas was considered as the basis for laying out the review of platform business model. The following section upholds literature review on supply chain management. The chapter ends with presenting a conceptual model, which is drawn on the basis of reviewed domains.

2.1 Understanding urban data platform

2.1.1 Background on urban/city data platform

The core to urban or city data platform is the data itself which is considered as asset, and the purpose of data, just like any other asset, is to assist in taking strategic administrative decision making and to ease the city bureaucratic processes, that leads to city development. Data that are generated by citizens or stored in municipal records can draw city operations process insight, critical insights to address ad hoc emergency instances, analytical insights that help future prediction and innovative development and strategic insights for improving decision making capability. (Schieferdecker, Tcholtchev & Lämmel, 2016) The importance of city data in establishing urban data platform can be observed in the Memorandum of Understanding on European partnership on “smart cities and communities” held on 21st May 2015 taken by European Commission ("Memorandum of Understanding - Towards Open Urban Platforms for Smart Cities and Communities", 2015). Since there are already numerous commercial data platforms for helping data-driven decision making, and on top of it citizens of a city are continuously generating large number of data, it is therefore imperative for governments to play a central role in managing these copious amount of data (Barns, 2018). Consequently, a data platforms work is to muster all data from different sources (such as different city organizations as static data and dynamic data from activities performed by citizens and IOT devices) into one place, thus reducing the stress of users to search for data in different

portals. (Schieferdecker, Tcholtchev & Lämmel, 2016). The open data principles[2] support city data platform explanation as it enables public and private organizations to publish data in an open data platform, provided in a universal format and accessible by anyone (Lapi, Tcholtchev, Bassbouss, Marienfeld & Schieferdecker, 2012).

Even after having implemented a data platform, it does not necessarily mean that it will create value for everyone until the city itself includes a cooperative data governance model that will include participation of external parties such as citizens, businesses, non-profit and educational institutions etc. Meaning that everyone inside a city should be able to access, capture, modify and reuse the data without restrictions thus replacing the traditional top down process structure. (Goldsmith & Crawford, 2014, cited in Barns, 2018) This idea of government opening up is a concept referred to "governance as a platform" or "Government 2.0" (Barns, 2016). Taken this concept into consideration UK has built a data infrastructure on which new software product or services can be built. US administration has initiated "Open Government Directive" to publish government information along with allowing participation and collaboration transparently. Whatever the type of data platform is and whoever maintain platforms, all data portals hold mutual service design. Structures of such design will typically include visualizations, widgets and analytical services based on data that are connected to city operation (Kitchin & McArdle, 2016: 2, cited in Barns 2018). In 2011, Singapore government took initiative to create a one-stop portal, where they would publish publicly available data, captured from 70 public institution. The portal, known as "Data.gov.sg", is presented to the public in a more meaningful and transparent way with the help of visualization. ("Data.gov.sg", 2011) Contrarily UK, with the help of University College London, has created "CityDashboard" to combine eight cities information, observational and social media data into one place to provide "at a glance" view. This mere representation of data has gone beyond visualization of data to city performance management after the establishment of new ISO standard for city performance metrics in 2014 (Barns, 2018).

[2] Open data principle comprises of 8 principles in opening government data. More about the open data principles are found here https://opengovdata.io/2014/8-principles/

Depending on the vision, data platforms objectives, functionalities and properties will vary and thus can be controlled inside or outside the boundary of government. Inspired by open data strategy, data platform that is co-operated by external parties such as university or innovators is often seen as data showcases, mostly to visualize data to a bigger audience. Amsterdam's approach to data platform is a good example of data showcase, where they encourage businesses and developers to build product and service on top of their data platform ("Dataportaal", n.d.). Data showcases are similar to that of open data platform. As Lapi et al. (2012) illustrated in their work that open data platform, that invokes open contribution, stores datasets, catalogue metadata, and scalable option for community activities as in open criticism, feeding and sharing data into the portal. Yet another type of data platform is the one that will lead to a marketplace of product or service. In this scenario, the objective is not to publish real time information of city, but to make raw data available in the data marketplace, so that two-sided market as in consumer and businesses can engage and create value for each other through data service. The City Data Exchange, owned by Copenhagen, follows similar strategy. The portal, that is maintained by technology company Hitachi, offers raw data in several standard formats to users. However, focusing software as a service platform, it walks towards a data marketplace, while it fails to evaluate and control the performance metrics. ("City Data Exchange - Smart Copenhagen", n.d., Barns, 2018) Data platform can also solely be created for internal value creation for the administrative performance of city offices. In this case the municipal is not trying to publish the raw data or information to the public, rather they exploit the data to enhance their internal workability and subsequent public services. To achieve that city first set performance indicators and evaluate the progress periodically using performed data. In addition, for the sake of transparency, these platforms convey the performance report through data portal to public as well. Barns (2018) call them score cards.

The biggest challenge of investing in an urban data platform is to understand the utilization of the data platform in the first place. First of all, market for urban data platform is still to be recognized. Demand of data is not certain and apparent due to lack of incisive interpretation of usability, as much as it is on the supply side, as zero ascription of accepted standards are set for supplying data. Interoperability issue has added to this complexity. This is why the MOU mentioned earlier has been created for singular understanding of urban data platform. (Schieferdecker, Tcholtchev & Lämmel, 2016) Be

that as it may, there are numerous applications of data platforms in real life as well. An analytical platform example is formed when IBM had partnered with city office in Brazil to collect from different city domains and 30 agencies. With mathematical model and intellect from analytics team, it observed the dynamics of city life. Based on a predictive model set based on these past occurrences, city officials now can log in to the platform system to retrieve real time information and respond to an incident live. Another practical open data innovation is SmartSantanderRA, which uses municipal operational data to provide information of 2700 locations in the city, all augmented throughout the app. (Kitchin, 2013)

2.1.2 Technical infrastructure of urban data platform

The goal of an 'one portal for all data' is so that any interested parties, whether they are data consumers or data providers, businesses or research institution, can explore preferred catalogued data in a centralized site, then capture and use the data of choice for further purpose (Lapi et al. 2012). The problem to that is different city offices use different data models and data repository architecture. Data in these different city office databases are diverse under spatial, temporal and thematic nature and thus has created data silos. These variation in data, when putting together in one place, may show contradictory and disconnected information. To address this issue, Psyllidis, Bozzon, Bocconi & Titos Bolivar (2015) proposes a semantic enrichment and integration component in their proposed system that uses a framework to simplify the data and its usability value. The system, ideally a knowledge base or representation model, includes a semantic model that defines urban systems (environment, transportation, health, education etc), the respective data sources (municipal historical data, sensor and social media data) and then clarifies the relation among them to address the data silo issues. Having such knowledge base model would serve two purposes: to create a predesignated knowledge base based on data domain, data source and field values, and secondly to clean data during later stage with reference to this knowledge base. Their work had considered not only municipal data, but also sensor and social media data, which altogether create a heterogenous data environment. Another way to tackle data silo is to catalogue data, as by doing so all metadata will be put in one central place (Lapi et al. 2012). Applying a meaningful and well-structured meta data can solve the problem of having information in different government websites. Meta data is attributes of datasets which is meant to assist in

discovering and browsing data. Some examples of meta data are title, subject, keywords, publisher, license terms, coverage period etc all of which are provided by the data publisher (Lopez et al., 2012). Because consistent meta data across different data bases can help discover data. There are catalogue softwares in the market that are able to store well-defined meta data with meaningful semantics and syntax. Such software will allow developers and other data portals and sites to access API to get data resource (Lapi et al. 2012). As cataloguing datasets and metadata into platform are important, Comprehensive Knowledge Archive Network, shortly known as CKAN, is global standard to catalogue meta data, that can be considered here. CKAN allows web access along with profoundly organized REST API. Moreover, CKAN also supports meta data catalogue vocabulary, called DCAT. Formatting data is another criterion for structuring governmental data in one place. Thus, JavaScript Object Notation (JSON) format, as is exchanged by CKAN, fills the gap. JSON is made in a way so that anyone can easily read and write the text format, as well as for the machines to analyze ("JSON", n.d.). All of this backend technical infrastructural guidance is essential for external developers, innovators and data providers. (Schieferdecker, Tcholtchev & Lämmel, 2016, Lapi et al. 2012)

The storage of data itself and connecting the relationship among different datasets is done using linked data[3]. Data, that are accessed through API, can be formatted in different formats such as pdf, csv, RDF and so on. Many would suggest using RDF as an example of linked data storage format due to its strong expressiveness in maintaining data quality and ease of usability. Although metadata is often used to connect between multiple datasets, leveraging RDF would even make it easier for developers to go back and forth across multi databases to capture the data constituents. The next logical step after data storage is to analyze, format and clean the clutter from data. As the name suggests data cleansing is the process through which the quality of data is evaluated from a data source. This can be done with the help of data quality service (DQS). Both computer assisted process and interactive human involved process are included in the system. Cross-checking with knowledge base (or knowledge representation model, as mentioned earlier), the first step is executed with computer assisted process, where the system filters

[3] Linked data is considered as best practices to establish link between interlinked datasets across database system. Linked data- connect distribute data across the web: http://linkeddata.org

incorrect or incomplete data, provide an alert, suggestion and direct correction. In the following step, a data steward will check the correction or suggestion made in the earlier stage and decide to comply or make change to data to conform the dataset to the knowledge base. Data domain values, domain rules and reference data have also been considered while cleansing. Below figure demonstrates visually how DQS works. ("Data Cleansing", 2012) However, when the data is too unstructured for machines to read, analyze and clean, intervention from human computational techniques would be effective in terms of assimilating diverse personal, contextual and cultural raw data (Psyllidis, Bozzon, Bocconi & Titos Bolivar, 2015).

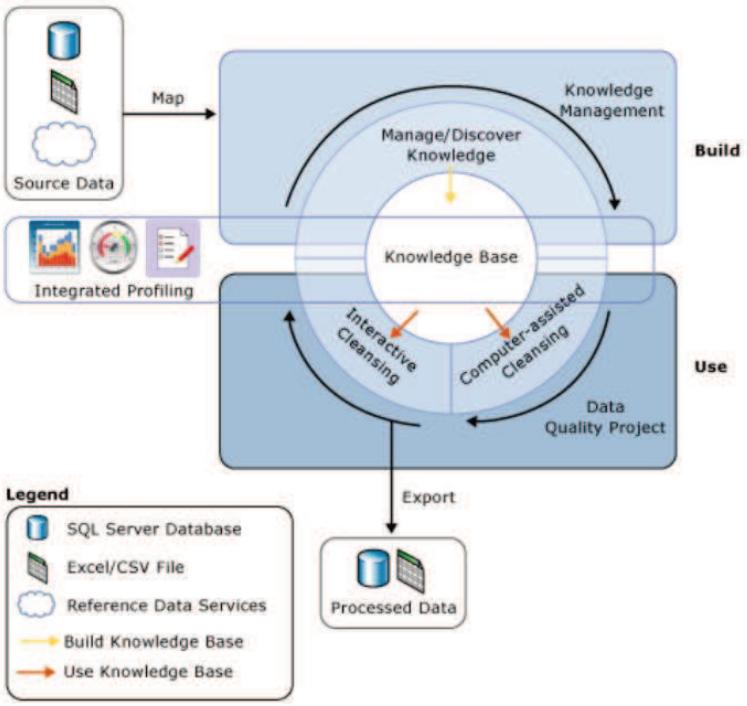

Figure 4 Data Quality Service borrowed from Microsoft

After all the activities made to set up the back end technical layer, a front layer has to be there to let users interact with data for their own motives. Hence data discovery and exploration can be achieved by implementing an interface that will present datasets and their respective meta data, visualization of information related to each data sets or an aggregated view of city dynamic information, a data analytical service that can be tweaked according to the need of users and so on. (Psyllidis, Bozzon, Bocconi & Titos Bolivar, 2015). For example, Amsterdam city data portal shares a map-based option called “data on the card” that allows users to browse maps and locate different topographies such as ‘business investment decisions’, ‘municipal restrictions’,

'UNESCO World Heritage zones', 'transportation risk zones', 'surveillance areas', 'monuments' etc. Similarly, another functionality called "map of maps" allows users to select specific neighbourhood and look up facilities in that vicinity for distinct purposes. ("Dataportaal", n.d.) While visualization in Amsterdam city data is fine grained, Singapore governmental data is exploiting graphic visuals intelligently to first present the country statistics in the front interface and a sample of data statistics in each dataset interfaces ("Data.gov.sg", 2011). Due to data cataloguing, users can probe into spatial, temporal and domain relevant data under precise urban environment with data exploration tools. These tools will enhance user information retrieval experience by providing customizable inquiry options of filtering data according to source, type of visualization and method of filtering. The most intriguing advantage of such tool is that not only users are enabled to search specific datasets, view graphically and analyze thereof, also the analysis can be exported in several formats for further use or sharing later on. (Psyllidis, Bozzon, Bocconi & Titos Bolivar, 2015).

To summarize the chapter, there are two perspectives needed to consider when initiating an urban/city data platform. One is organizational aspect that includes the organizational structure and mechanism such as service design, visualization, analytical services, data governing model etc. that fosters the development of data platform. To complement organizational structure, technical infrastructure such as data management systems, interoperability issue and technology enabler have to be built. Both perspectives need to comply with city's strategy and vision for long term plan. In this case the strategy is to transform into smart city and deploying urban data platform as a heart for innovation towards that goal.

2.2 Platform as a business model

The inception of "platform" is dated back in 1990s when researchers had started examining the platform ecosystem in terms of design, technicality, characteristics, pricing, and control and governance mechanisms and so on. A platform can be defined based on its orientation. A technology-oriented platform is established by one or many firms, and thus create a ground on which other firms can act upon to build complementary products, services or technologies. Whereas a platform with market orientation is enabled by intermediaries and focused on letting numerous users interacting with each other to

create network effect. This interactive based platform functionality is also supported by Baldwin and Woodard (2008), cited in Schweiger et al.' work. Here the market orientation is termed as industrial economy. This type of platform is a combination of technical and non-technical attributes that provides service based on users' interaction. Platform can also be applied in the world of tangible products, where platform serves as the foundation as products from different product groups complement each other by sharing modifiable features in order to achieve economies of scale. (Schweiger, Nagel, Böhm & Krcmar, 2016) Intermediaries who father the platform, allows two or more distinguishable group of customers to join and connect with each other dependably by using the platform (Schweiger et al. 2016). Hence the name multisided platform is captivated. For consistency purpose, only multisided platform business model is reviewed throughout this chapter.

2.2.1 Platforms value proposition, user relationship and achieving critical mass

Interestingly, value proposition and the offering from the platform can be differed according to the user group. Peeking into consumers motivation, one might say consumers are attracted to platforms due to its value offering whereas the other customer group, often the business customer, does not get any direct value offering from platform, rather becomes intrigued by the size of the consumer group and benefits associated with it. This is apparent is Fish's (2009) statement as well that companies will generate business out of consumers' private data in two-sided internet-based market. While freemium can be a good strategy for consumer attraction and reaching critical mass, for revenue generation and to balance subsidized pricing, platform must also devise value for business customers as these customer group will subsequently consider business opportunity associated with consumer audience and therefore join the platform through premium subscription (Mahadevan, 2000; Osterwalder et al., 2010). Another fascinating characteristics of two-sided platform business model is value co-creation. Muzellec, Ronteau & Lambkin (2015) propose that internet-based platforms do not allow reciprocate value creation, and thus negotiation, as considered the path to co-creation, is absent for end consumer. They suggest that end user in fact is the value offering for business user in the platform. However, there are several things need to be considered while factoring the platform success. Changes in business environment and adopting to

such changes is paramount for platforms to sustain over time. It has been suggested by researchers that business model should be converted from free access to priced access to the platform in future (Duval & Brasse, 2014). Customer relationship as a part of business modelling and platforms orientation based on relation play significant role in value creation. As Hagiu and Wright (2018) identified "affiliation" as one of the two key characteristics that multi sided platform displays, attracting customers/developers and achieving critical mass is important. First of all, both end user and developers or innovators should be considered as customer of the platform. Consumers often would need to share their personal data in digital platform and therefore trustworthiness must be gained; Similarly, platform owner must provide secure technical working environment and issue policy and regulation in regard to financial value generation for business customers.

Network externality and succession in critical mass are subject to investment decisions and pricing strategies taken by platform. Faced by the so-called chicken and egg problem[4] (Gawer & Cusumano, 2002), multi sided platforms need to plan to get both side of customers into platform. One example of attracting one side of customer groups is just to offer the platform completely free or sometimes paying to experience it, which is very effective in the beginning phase of a platform business. However, investing in 'business customer' is also another mean of achieving critical mass. The objective here is to ease the procedures, access and technical infrastructures for developers or innovators by providing added assistance from platforms end, which actually supports customer relationship findings mentioned earlier. Offering low prices to enter the platform is another way to induce one customer side to join platform that in turn will create network effect and consequently sways the other group to participate. Myriad benefits seen from such strategy include discouraging developers to focus less on competitive platforms. (Evans, 2003) Despite several strategies, in the entry phase, platform business should incorporate only one value proposition pertaining to one revenue model rather than considering multiple values in order to achieve critical mass smoothly. In addition,

[4] Chicken and egg problem is a state of confusion, as to decide which one comes first. Chicken and egg problem has been observed in organizational business settings.

companies should reimagine their business model following the critical mass (Lai, 2014, cited in Schweiger, Nagel, Böhm & Krcmar, 2016).

2.2.2 Platform Key activities, resources and networks

In a multisided platform business, platform owner, lets interact two sided groups through the sharing of resources in the platform. Marketing efforts are not usually taken by platform, rather taken by business customer towards consumer sider. In service dominant logic, an interactive relation is established when resource is mutually shared among participants. In digital landscape, channel of distribution and its process mechanism becomes the key activities and selling point instead of the actual product or service (Vargo & Lusch, 2004, 2008a,b, 2011, cited in Muzellec et al, 2015). The value co-creation in platform can also be explained from perspective of platform business ecosystem. In a business model, key partners with the platform owner creates altogether the business ecosystem. Key partners, also called stakeholders, are groups or individual organizations which induce the performance, policies, practices and objective of the ecosystem. Depending on the business context, types of stakeholders may differ, however in a general business environment, a consensus on possible stakeholder includes employees, suppliers, government, shareholders, consumers, local communities, competitors, media, NGOs etc. (Carroll and Buc- hholtz, 2000, Freeman, 1984, cited in Heidrich, Harvey & Tollin, 2009). The effectivity of having multiple partners in the platform ecosystem is not just to create value for each other but also to turn the fixed cost into variable cost by sharing with partners. This is possible due to firm's shift from pipeline to platforms orientation that enacting interaction between outside innovators with consumers. Therefore, role of partners/actors is decisive in developing the ecosystem itself. To manage external partners, a platform should smartly govern by encouraging them in accretive activity-based interaction that refers to role swapping. Airbnb is perfect example in such scenario, where a consumer today is a service supplier tomorrow for another consumer. Reversely a depletive role can drive down platforms resources since actors manipulates platforms resources in their own advantage. ("Pipelines, Platforms, and the New Rules of Strategy", 2018)

2.2.3 Platform business cost and profit structure

Typically, in an internet based multisided platform business, there are two group of users: end consumers who enjoy the benefits offered in the platform for free and business customers who usually pay to use the platform (Muzellec, Ronteau & Lambkin, 2015). Who would pay and who would not among the participants depends on network externality[5]. As a result, reduced optimal price with that of marginal cost for one group of customers is possible to exist in platform business (Parker and Van Alstyne, 2002, cited in Evans, 2003). In a multi sided platform market, this optimal price is offered by balancing the demand of this particular group (Rochet and Tirole, 2002, cited in Evans, 2003). Cost structure and with that of revenue generation, therefore, are the two fundamental domains in developing business model. In a multisided market, there is a significant price disparity between users in the platform ecosystem as in one side is heavily priced, other one is either exempted or optimally priced. Pricing strategy can depend on the buyer and seller as well. (Evans, 2003)

At the end of the day while modelling pricing for multi sided platforms, several factors need to keep in mind. Firstly, platforms subsidize user group with positive network effect and that will be able to capture cross-side network effect. Secondly platform must subsidize user group who are sensitive to price and charge the other side since the latter are more willing to pay to reach the opposite user group. Thirdly, Charging the side who maintain the quality of product or service being delivered and subsidizing the other group who expects and prone to experience quality. Costs of production as the fourth factor to consider while developing pricing. For digital products cost of production is close to zero and one user group can be easily subsidized. While there are advantages of positive same side and cross side network effects, negative same side effects, the fifth factor, can put adverse effect too. Platforms should govern users in a way that sellers would not feel threatened even after the existence of numerous competitive sellers. At the same time,

[5] Network externality basically refers to either an increase or decrease of value of platform due to the rise of demand of one user base. If the demand rise from one user group positively or negatively affects other several groups within the platform ecosystem, then it is called cross-externalities. For instance, the more people have a video game console, the more game developers have an interest in developing games for it; the more games available for the console, the more people will buy a PlayStation (Hagiu & Wright, 2015).

putting regulations that limit sellers' monopoly will encourage subsidized group to continue their transactions. Sixth, there is one type of buyer, referred as "marquee buyer" can affect pricing strategy in the platform. If the presence of marquee buyer is appreciated by the other side of the platform, for example, sellers, then price impose will shift from these buyers to their seller, the interested parties. (Eisenmann, Parker & Van Alstyne, 2006)

2.2.4 Sustainable platform business: governance, control & evaluation

While business modelling in general is creating value for companies and its stakeholders economically, a "sustainable business model" will be one that considers external stakeholders to create value not only economically, but also socially and environmentally. Governing operating policies and practices such as "shared value" is therefore the loophole to competitiveness of a sustainable platform business. (Boons et al., 2013; Lüdeke-Freund, 2010; Bocken et al., 2014, 2015; Stubbs and Cocklin, 2008; Porter & Kramer, 2011 cited in Piscicelli, Ludden & Cooper, 2018) Which means that partners or stakeholders in a given ecosystem will control each other's action while creating value for each other concurrently. Linking sustainability with business model can be manifested through continuous model development as the business ecosystem, its actors and resources change over time (Muzellec et al, 2015, cited in Schweiger, Nagel, Böhm & Krcmar, 2016). The paper therefore defines that if platforms create value that serve purposes for actors in the ecosystem while boosting the economy without harming the environment then a sustainable platform business practice is formed. To do so governance mechanisms need to be established.

Platforms governance structure as a mechanism affects its openness (social sustainability) and commercialization (economic sustainability) success along with achieving user base. At one hand, centralized platform will give less transparency, partial or no user involvement, quality assurance to user, and full control (set up, price, rules) to owner. Uber, the peer-peer ride sharing platform allows consumers to rate drivers to eliminate low rated drivers from the platform, and at the same time charges a high price margin. However, Uber is seen as both centralized and decentralized platform, whereas Apple is a perfect example of fully centralized platform that gives limited access to users. On the

other hand, a decentralized platform will help cultivating a solid user base with some loss of control, full of quality issues and commercialization failure. Again, ecosystem sustainability can be attained when external businesses are allowed to access and create opportunities on platform business, which directly connects to platforms resource governance. Choosing preferred target user and giving access to these group is another mechanism to administer the platform. Accessibility overlaps with openness and platforms operational phase. More open platforms tend to attract user base rapidly to reach critical mass while bringing negative effects along with it. Top business firms like Alibaba and Facebook started with allowing access to limited user group such as Chinese user and university students respectively. Trust and risk, another two important factors which consider internal actors perspective that influence in sustaining platform business. In tempting customers in online transaction, trust plays the most crucial role (Quelch & Klein, 1996). Trust is considered as one of top 10 impediments in e-commerce sector. In addition, in order for a consumer to participate in an online commerce, trust is given as the primary condition. (Corbitt, Thanasankit & Yi, 2003) Similarly perceived risk is characterized by two factors: probability of consequences occurring and negative consequences of poor decision making (Mitchell, 1992). Trust and perceived risk are rights that user holds and demonstrates during interaction. Businesses trade off to balance between trust & risk and transparency & financial success. (Schweiger, Nagel, Böhm & Krcmar, 2016)

Carrying platform from beginning phase to a more mature one requires extensive and distinct monitoring and pivoting based on pre-set evaluation system. A platform's success is solely based on interaction, and therefore "interaction monitoring" should be one of the criteria to assess the fruition of the platform:

- Interaction and network effect are interdependent on each other, thus if one user side fails to reach the other user side, the whole platform will fall apart. To avoid this a balance between effective supply and demand of user interaction needs to be managed.
- Engagement as a form of social interaction or repeat buyer-seller transaction is another metric for measuring the performance. Innovations that boost engagement will result in more interaction.

- Platforms should weigh demand side with that of supply side to match and thereafter can estimate the progress of platform.
- Employing deferring regulatory policies in the platform would help reduce negative network effects to sustain the platform growth.

Even though a metric is core to platforms growth and success in the long run, without the firms' leader's conformity to the new platform business practice, often firms will fail to actualize their effort in platform business. ("Pipelines, Platforms, and the New Rules of Strategy", 2018)

2.3 Supply chain mechanisms

The purpose of this chapter is to explore supply chain mechanisms to identify key instruments to connect it to this papers research objective. I will first familiarize the overview of supply chain landscape in general, and afterwards, will only discuss perceived potential key practices (those seem more appropriate with research context) from supply chain literature.

What constitutes supply chain and its management is a difficult question to answer since varied perspective has been observed in literature and by practitioners. Transportation and logistics literature views supply chain management as the medium of distributing physical goods as being the final product and integrating logistics system efficiently to the final consumer without focusing on the transformation of the product itself. (Lamming, 1996. Cited in Choon Tan, 2000) while the preceding definition sounds disintegrative, supply chain management can also be seen from objective perspective. RB, Jr EL. (1999) refers supply chain as a bunch of activities that concatenate transformation flow of raw materials into final goods, and associated information flow with the final consumer (Presutti Jr. 2002). Supply chain becomes value creative activities when multiple stakeholders such as manufacturers, wholesalers, retailers and final users are considered as contributor along the chain by creating value as such starting from extracting raw materials and ending with recycling of consumed goods. Unlike previous definitions, authors suggest it as a true integrated form of chain that includes planning, product design and development, sourcing, manufacturing, fabrication, assembly, transportation, warehousing, distribution and post delivery service. The design would

enable end user to pull the product from value chain. (New & Payne, 1995. Cited in Choon Tan, 2000) Management of supply chain can be of three-fold: the revenue coming from a consumer's order, the cost associated with delivering the order and the satisfaction of customer. So, the supply chain management can be defined as how to manage the process, operations, resources, information and funds in order to maximize the effectiveness and efficiency of these three folds (Hassini, Surti, Searcy, 2012).

Management perspective of supply chain however has been evolved over the years. Assurance, partnership and collaboration among upstream businesses as in supplier or vendor and downstream businesses as in wholesaler or retailer have now become central objective of maintaining a low-cost value chain while delivering superior product or service quality to end consumer (Christopher, 1992, p. 3). Sustainable supply chain management has become a major conversation topic globally as a recent development and thus numerous academic work has been done on restructuring the supply chain accordingly. Sustainable supply chain management can intake two sets of activities. In the first set it specifies the management of materials, information and capital flow, while in the second set it obliges to collaborate with companies along the supply chain for cooperation in sustainable development domains such as economic, environmental and social. Stakeholders like customers and value chain companies will predefine their sustainable development requirements in order to balance the sustainability. (Seuring & Müller, 2008)

2.3.1 Supply Chain components: procurement, logistics, demand management and customer service

According to the author Arjan J. Van Weele (2010), the definition of purchasing or procurement in supply chain is "the management of the company's external resources in such a way that the supply of all goods, services, capabilities and knowledge which are necessary for running, maintaining and managing the company's primary and support activities is secured under the most favourable condition". Electronic procurement would be more suitable topic to discuss to help achieve this papers objective. Electronic procurement is the technology solution for making the purchasing easy for industrial companies. To reduce time to market product and filtering suppliers while sourcing of materials process, e-procurement is effective. The capability of electronic purchasing extends to managing inventory level at buyers end that will again result in cost reduction.

E-procurement allows to incorporate new value creating activities such as e-design in the early phase of product manufacturing and supplier evaluation electronically as well. Procurement using software tools or electronically, helps managers in getting close to accurate projections on expected buying ratio. EDI, otherwise known as electronic data interchange is considered as the e-procurement tool that has been used by large firms for many years now. (Presutti Jr. 2002) An e-procurement, besides improving the external coordination as mentioned above, can also enhance internal functions of the buyer itself through collaboration among different functional departments such as marketing and sales, manufacturing, finance etc. The benefits of such integration are accurate forecast of product demand and reduced time to market for new product development. (Samson, 2011)

Logistics, as another supply chain component, can be defined as functional activities that monitor the flow of materials or inventories and information, coming from suppliers end and finishes up at consumers end. The very first application of logistics was originated in military and extended to manufacturing companies to service companies also these days (Ghiani, G., Laporte, G., & Musmanno, R. 2013). Logistics therefore include far ranging activity pillars such as transportation, inventory management, warehouse management, material follow-up, packaging and containment of the flow of information. (Shamim, 2008) A complete logistics strategy can be formulated through a facilitation of a management of logistics system. Such system comprises of three phases: *planning* that is associated with taking best logistics decision, *organizing* that refers to the human involvement in logistics activities and *controlling* that is created for assessment of the system. (Ghiani, G., Laporte, G., & Musmanno, R. (2013))

Demand management is a continuous process of balancing customers' requirement against that of the manufacturers supply chain capability to meet that demand. So, variation in the demand and the flexibility of manufacturer to address the demand are two crucial factors in demand management. Depending on the context and industry, the demand strategy might vary from reducing demand variability to improving flexibility. (Keely L. Croxton, Sebastian J. Garcia-Dastugue, Douglas M. Lambert and Dale S. Rogers, 2001)

However, Until or unless the customer or consumer is consuming the value and benefitting out of the product or service, the product made or service waiting to be

delivered will be in vein. This sense brings us to the next obvious step, which is making the product available with the help of supply chain. Making the product available with proper order cycle time and with a perfect order (Blanchard D. 2010) would create a proper ***customer service***. From the perspective of supply chain, customers prefer companies that can maintain "perfect order" and shipment in every transaction they make. A perfect order, from the definition of Edward Marien is a list of customer rights during an order. These are

- The right product
- Right quantity of the product
- Right source for the customer
- Right destination
- Right condition of the product as promised
- Right timing
- Right documentation against the order
- Right cost

2.3.2 Supply Chain management: Key practices

While there are plenty supply chain issues to review, only supply chain practices that are applied in business and deemed connected to this paper are discussed in this section. Moreover, some modern supply chain backgrounds and techniques are also discussed. Both the usual and modern application of supply chain management have been highlighted and leveraged in order to build the conceptual framework later on.

Make vs Buy

One important strategic decision, a firm needs to make is to decide whether it conforms to vertical integration or outsources its activities and operation to an outside firm.

Globalisation, as considered by many, is one of the factors for firms to outsource its production or business process to another company. when it is neither time favourable nor cost-effective to build an advanced technology require to produce the product or service in house, then firms can look into outsourcing such operation to outsider (Trunick, 1989). The third-party logistics firm, having greater skills in a specific area, can improve control, technology and location efficiency, which will convert the buyer's fixed cost into variable cost, another reason for shifting towards outsourcing decision. (Lacity C., Khan A., Willcocks P., 2009)

Vertical Integration VS Value Adding Partnership

Modern supply chain management, however, emphasizes more on value adding activities rather than traditional outsourcing or vertical integration orientation. When several small independent companies work cooperatively to manage and control the movement of goods and services from point of collecting raw materials to the point of sale for end consumer, otherwise known as the value chain channel, then such formation of companies would be named as "value adding partnerships". These small companies only take care of one step from the entire value chain activities; thus, companies can afford lean staff and management along with low overhead cost. What makes this partnership so successful is that the coordination and information sharing among partners. They share a common goal and each care about the other partners and their success and failure in the chain. Likewise, information is dispersed along the chain to keep the partners aware of the market competitiveness and changes in the market. Hence, they coordinate their own activities with that of their relevant business partners (Johnston & Lawrence, 1988).

On the other hand, Vertical integration is established when two businesses of same or different stages of production merge together to enjoy benefits such as controlling cost, quality and delivery of inputs. The problem with such integrated company is that they concentrate only one competitive aspect (for instance cost reduction) throughout the whole organization and therefore would fail to realize other competitive advantages in different organizational functionalities. Unlike that, disintegrated VAP firms can work independently but coherently while conforming to a set of rules that are governed by them in the first place. (Johnston & Lawrence, 1988)

Customer Relationship Management

Heavily focused on customer centricity, CRM is the managerial approach of enhancing organizational profitability, revenue generation and customer retention and satisfaction. CRM is also referred as a technical tool, which incorporates front office and back office task for the purpose of total integration between these two to provide a 360-degree view of a company's operation (Blanchard, D. 2010). Smart and competitive firms have implemented relationship-marketing strategy through the establishment of CRM application that allows one to one communication and personalized service. Consequently, the reason for CRM to exist is to increase revenue, decrease operational cost, boosting customer satisfaction and retention rates through relationship building. The success of CRM lies in retrieving customer data from online or offline touch points, and thus receiving a comprehensive view of customer profile and their buying pattern. (Chen & Popovich, 2003)

Knowledge sharing

Since sharing knowledge occurring in organizational context, understanding the concept from this perspective is important. Knowledge transfer will take place when someone will gather information, process, use it for internal purpose, share new insight or original information across and beyond company boundary. So, it's a process that includes movement of work-related experience, know-how and contextual information. (Lin, 2007) In modern supply chain, knowledge transfer becomes knowledge exchange, a reciprocation of information in operational and strategic level between partners in the value chain. The result is improved demand management and delivery of product or service, followed by customer service (Kwon and Suh, 2005, cited in Wu, Cheng, & Huang, 2010). The effectivity of knowledge transfer in sustainability is also visible as study from Sarkis (2004) suggests that due to information exchange in external green supply chain management, companies are successful in increasing economic and environmental performance. (Wu, Cheng, & Huang, 2010) Thus organizations need to identify the critical factors to create a knowledge sharing environment, which consists of trust, motivation for sharing, culture, security support and process. (Brachos et al., 2007). Toyota's approach to knowledge sharing touches all the critical factors. The company gives free assistance and internal operational access to suppliers. It also has activated sharing culture by offering reward for exceptional knowledge sharing to create new

business opportunities (Dyer, J. H., & Nobeoka, K. (2000)). More interestingly, for gaining global collaboration in knowledge transfer implementations of ICT applications play a supplementary role in efficient information transmission (Pan and Leidner, 2003 cited in Lin, 2007).

Collaborative Planning, Forecasting and Replenishment (CPFR)

The difference and uniqueness between CPFR and traditional demand planning is that while the latter uses gross sales unit and stock inventory forecast, the former intelligently exploits and shares demand information flow with the key players along the supply chain to plan, forecast and replenish inventory collaboratively. This supports with the discussion presented earlier in the section "vertical integration VS value added partnership" also. The CPFR creates a vendor management inventory (VMI) environment where suppliers take control of collecting information of product usage by customers from point of sale or point of consumption. More specifically suppliers will be in direct contact with reseller or consumer to collect demand intelligence and control inventory flow in the supply chain. Because of the information visibility among partners in the supply chain, the cost of buffered stock is decreased. Mostly popular in retail industries, CPFR framework, developed by US-based organization, VICS (Voluntary Inter-Industry Commerce Standards), can be applied universally. The far-reaching benefits of having implemented a CPFR program ranges from reduction in inventory and capacity storage, hence reduction in inventory carrying cost and improved forecast accuracy alternatively, reduction in excess and obsolete inventory and in lead time, and thereafter increase in revenue. (Christopher, 1992, p. 94-97)

Assemble to order

In simple words, assemble to order is a production strategy, where manufactures purchase and store components of the final product beforehand, and only after receiving customer order, the components are assembled to finished product. The target apparently is to maximize customer service by reducing order cycle time and to minimize the operating cost. (Atan, Ahmadi, Stegehuis, Kok & Adan, 2017)

2.3.3 Sustainable Supply Chain Management

According to environmental management, organizations don't consider adding environmental practice into their operational performance management until it gains experience and stability. This is when to attain potential competitive advantage, firms incorporate environmental standards and metrics into organizational objectives. Inclusion of firms' effect on environment leads to reduction in product life cycle cost which in turn increases profit. Moreover, sustainable practice will cut costs of buying hazardous material in procurement stage. Consequently, if there is no material that creates waste, then there is no need for additional space, storing and disposal process of managing this material. Thus, cost reduction in waste management is gained. In addition, after adopting environmental friendliness in firm's business process and practice, it will be highly regarded by public authorities and regulations, and aggression towards firms will be decreased. By prohibiting waste producing activities into organizational system, firms essentially will practice corporate social responsibility, which means inhabitants, as much as firm's own employees are not harmed by the firm. (Cattanach, et. al., 1995, Zhang, et. al., 1997, cited in Beamon, 1999) Therefore it is pressing to prevent the creation of waste rather than managing it once it has been created. To do so, source-reduction/pollution-prevention strategy (SR/P2) strategy can be taken into consideration. (Srivastava, 2007) For sustainable environmental development in every business aspect, reverse logistics functionality has become a major trend for manufacturing companies lately. Reverse logistics is the flow of final products or services from end consumer to the producer's manufacturing plant for the instances like unsold product or return of products. The process of reverse logistics is maintained in a way that only non-functional products are being retrieved and send back to the manufacturer either for further reproduction or for disposal or for resale of the refurbished product. The beauty of such logistics is that firms can easily capture the value coming from the exhausted product that being used by final consumer even after the life cycle of the product is diminished (Ghiani, G., Laporte, G., & Musmanno, R. 2013). In a deeper definition, reverse logistics activities include processing damaged goods, seasonal inventory, restocking, recalling, excess inventory and retrieving products through packaging and shipping from consumer or reseller (Blanchard D. 2010).

So far, I have laid out basic knowledge about urban data platforms organizational and technical infrastructures and the fundamentals to govern it. I have also reviewed

multisided platforms business model and its characteristics in each sub section. The review on supply chain management dynamics have acquainted readers with key supply chain practices, components and strategies in brief. In the following and final section of the chapter I will describe and visualize the conceptual model which would reflect learnings from above studied three domains.

2.4 Urban data platform operation conceptual model

The intention of creating a conceptual model is to connect three diverse domains studied earlier into one piece, thus presenting singular urban data platform operating process consisted of multiple stakeholders and their value creation in the ecosystem. The conceptual framework depicted contains internal and external actors, components of an ideal city data platform and is subtly connected with supply chain management mechanism. Different city domain offices and domain experts, and the platform itself are the internal actors of the proposed model. Here only city offices are considered as the supplier of data. Whereas, businesses, developers, innovators, researchers, individual customers, government and others are considered as the consumer of data. Since the proposed model has taken supply chain into consideration and having found similarities between platform activities and supply chain processes, all stages of data platform activity is going to be described from supply chain perspective. Moreover, the proposed framework is inspired by past research on developing urban data platforms, smart city projects and different frameworks found in literature.

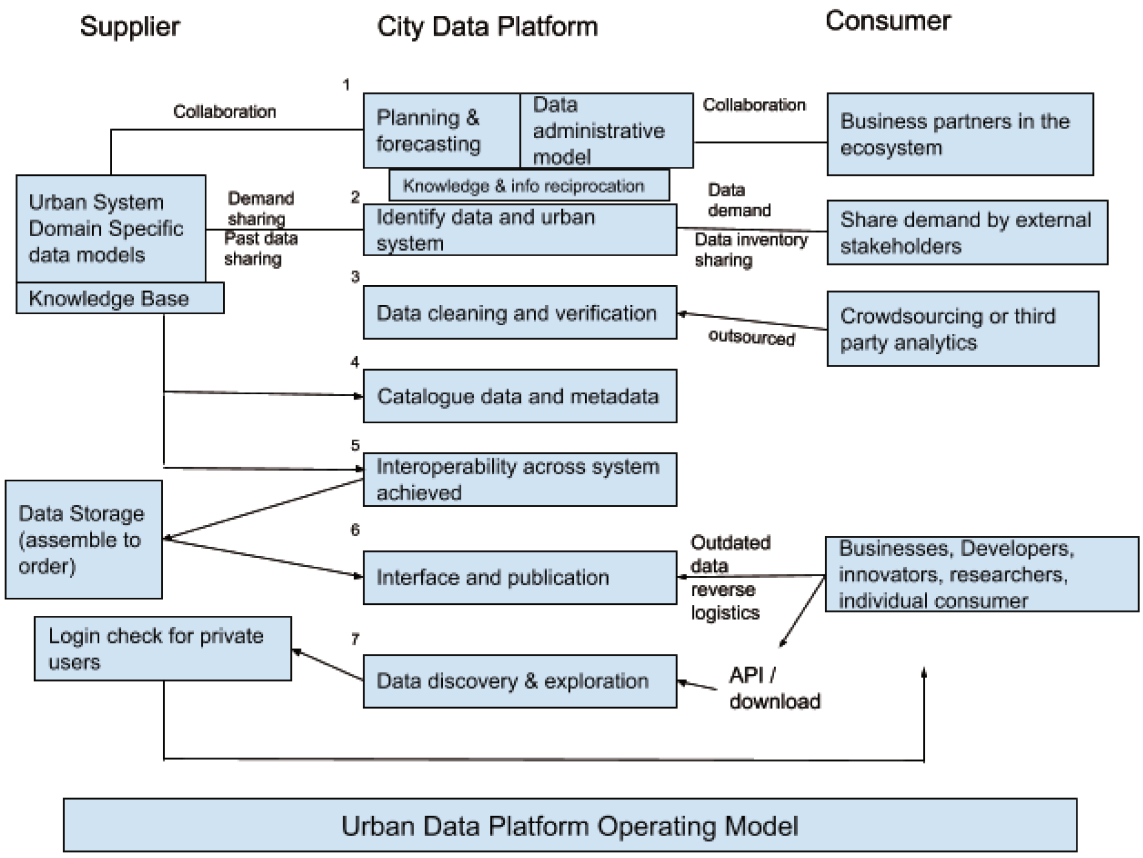

Figure 5 Proposed conceptual model of urban data platform's supply and demand of data management process

1. Planning and Forecasting and setting data administrative model:

Since the usability of data remains unsure of, understanding the demand is crucial for usability of the platform and supply of data and service thereafter. To do so, a collaborative approach is suggested. Therefore, the framework suggests that the first task of city data platform would be to form alliance with major external and internal stakeholders. Cooperatively they will plan (how to make data ready for use cases and how often sourcing of city data will take place), forecast (estimating the data demand and sourcing according to time and need) and stocking raw data as raw materials and datasets as finished data or service to meet the demand. Planning will also include the operational policy of managing data throughout the platform so that the platform would ultimately create value for each partner in the ecosystem.

Besides planning and forecasting, I also suggest creating a "data administrative model" (inspired by Paskaleva et al. (2017) work). The decisions of guiding the data will be taken together with major stakeholders along with the platform itself and should address below questions:

- Who among internal or external partners is responsible for planning and forecasting the data demand?
- Is there any data administrative model exist in the current governance policy?
- What technologies are needed to identify data and are these technologies sustainable and environment friendly?
- Does the current or proposed data administrative model abide by regional rules such as GDPR in Europe?
- Who is responsible for data verification and is the veracity of data being checked after data cleansing by external partners or crowdsourcing?
- Is the current data platform and its mechanism scalable in future?
- Is data privacy and security considered while publishing datasets?
- Are the platform system and data sourcing transparent to the audience, business partners and other actors in the ecosystem?

Data administrative model should comply with that of the data platforms model of technological and managerial operation. Planning for the data platform management and establishing a data administrative model should therefore the very first step of city data platform.

2. Identification of database system for Product design and development:

An open knowledge (both explicit and tacit) and information sharing environment should be established before commencing the actual task of the platform. The so called open knowledge sharing would work similarly the concept VMI that is vendor management inventory in supply chain management. In this environment, supplier of data (either city domain offices), Platform owner and consumer of data (external stakeholders) will be connected through sharing real time demand and raw data inventory information. Only selected external stakeholders will participate in the data platform ecosystem. In the first act, these external stakeholders will share their data demand to both supplier and platform. The demand may be driven by the need to resolve any internal problem or simply to

produce new service or products for customers. Consecutively, the data demand will be shared by platform to supplier to check if the demand can be met with existing or new data resources. If city domain offices already hold such or related data, then they will share historical record or datasets with the data platform in the following stage. Likewise, the city platform will convey data inventory information to these consumers. Note that aforementioned activity presents merely flow of information but not the actual task of delivering data. By establishing open knowledge sharing, knowledge transfer mechanism will be established, transparency will be achieved, and both time and operational cost will be significantly reduced for each party. In addition, sharing data demand will help both suppliers and manufacturers of data in designing a dataset or data product and service customized for that specific consumer. Thus e-design (another component of e-procurement) will take place, which will pave the way to product development. Product development will start with raw data extraction from source (city domain offices) and to clean to remove any irrelevance from the entirety of the data before populating it to the platform system. To do so, platform is suggested to partner with third party analytical service to outsource the complete task. This type of external partners will not only remove the clutters from data but will also verify the data truthfulness with emerging technologies, often referred as data veracity. Having such partner will be effective in future to outsource data analytical service, should there be any circumstances when the data platform is unable to do so.

3. Assembly and Manufacturing:

At this stage, the data platform will actualize the procurement activities that is to source systems that contain demand data. Assembling raw data and manufacturing them into datasets will commence after the cleansing process. Cataloguing data and metadata is the process of accomplishing several things. It will create relation across different and diverse datasets that are going to be published. Also connecting multiple external city systems into data platform portal is impossible before populating data and metadata. Based on past researches, a knowledge base, that contains domain corresponding data sources, properties etc., is proposed here so that interoperability is overcome, which is a major

issue in integrating silo systems. Cataloguing metadata improves demand flexibility[6] so that at the time of data discovery, consumers can find the data they are looking for. Meeting the demand means consumers being able to find or explore the data in this context. Finding and matching data is made possible by inclusion of metadata into system. By cataloguing metadata platform is eventually meeting the data exploring demand in the portal interface. By consulting with data consumers or companies, data platform will be able to identify/predict needed data and respective metadata, which they would source from their suppliers. They would also forecast, and store required data and metadata before publishing for future purposes. Given the inevitability of data driven economy in future of smart city, data capture and publication are unavoidable. Therefore, whether the data demand exists or not at present, the best step is to make the data source and raw data ready for future use. This ideology can be achieved by performing assembly to order. City data platform should spontaneously collect and store raw data and datasets beforehand so that when the time comes, it would be in position to provide data driven analytical service to citizens and other interested parties. Data storage as oppose to warehouse should be established in order to store these data for further usage.

4. Distribution and consumption:

The channel of distribution is the data portal itself. More specifically a semantically aware interface would be appropriate on top of the portal that would allow users to query that supports and matches metadata defined in earlier stages. Consumption will take place when users browse, discover, customize and store the datasets in their preferred location.

5. Customer service in urban data platform:

Customer service in platform are right product (right to receive correct datasets and API access), right condition of the product (right to expect universal and machine readable file format and size), right destination (right to get all diversified datasets from one data portal), right cost (right for open data for innovation and priced data for data services), right documentation against the order (right to customize according to need and

[6] In demand management context, companies can either control the demand or improve their ability to meet demand, latter is called demand flexibility.

visualization thereof), right timing (right to get datasets when demanded), right quantity of product (right to get explicit search results against given query), and right source of product (right of knowing the source of data from different city offices or sensors and media). Consumption of data through urban data platform and customers right to perfect order should resemble and meet the modern definition of supply chain mechanism that states that consumer will pull the value from the chain instead firms pushing consumers for selling the value (New & Payne, 1995. Cited in Choon Tan, 2000).

6. Reverse logistics:

This conceptual model has also borrowed reverse logistics terminology from supply chain management and applied in data platform context. Reverse logistics can be implied when data consumers especially business customers give back previously bought data set to the data platform. In many instances, due to rapid digitalization and urbanization, dataset can become obsolete and counterproductive. Instead of eliminating the used obsolete dataset, businesses should trade off the dataset with new updated dataset from data platform. To do so, the platform must incorporate reverse logistics mechanism that enable customers to return the dataset through the portal, followed by careful evaluation of the dataset by platform, which would eventually be restituted to data provider. It's the data provider who is accountable for repairing the data and further sale or publish the data later.

3 RESULTS

The objective of this research was to explore the urban data platform and supply chain as its operational mechanisms and to gain new insights on the relevance between urban data platform with multisided platform business model. Thus, the research includes exploratory research on three domains: urban data platform, platform business model and supply chain management. Building on three domains, a conceptual model has been built in the last chapter, on the basis of which three diverse real life urban data platforms (Turku data office as close platform, Amsterdam city data as open platform, Denmark open data as semi-closed platform) have been studied. Open ended questions have been developed and qualitative analysis has been conducted to extract insight from interview answers and content analysis using inductive reasoning methods. In the following passage, the key observations are presented in a table and later shortly described thematically.

Table 1 Result of three urban data platforms' interview and content analysis

Operational activities/ Factors	***Turku Data Office***	***Amsterdam City Data***	***Denmark Open Data***
Presence of procurement	Present; internal procurement	Present; internal & external procurement	Present; internal & limited external procurement
Collaborative planning and forecasting	Supports CPFR framework on ad hoc data demand basis	Does not exist	Supports CPFR framework on ad hoc data demand or use case basis, limited by membership
Presence of VMI environment	Does not offer at the beginning	Already exist	Exist for members only
Data cleaning & verification	To be outsourced	Performed by the platform	No information found

Data supplier	Municipal domain offices	Anyone	All members, including municipal cities
Data source identification	Only required during ad hoc data demand	Not required	No information found
Interoperability	Ready-made integration of datasets	Open source	Not enough information
Channel of distribution	Data portal	Data portal	Data portal
Data Storage	Data stored using product management process	Data source code is stored	Data stored in portal
Consumption of data	API access and data analysis by the user	Product or service development using data	Download and API access
Customer service	Both automated and face-to-face customer service	To the extent of assisting in guiding users in usage of data	Sharing of use cases of data
Reverse logistics	Not applied	Applied as in reuse of data	Not applied
Data administrative model	Present	Present	Present in the form of COC
Strong customer group	Business customer	Researchers, employees, chain partners	Internal city employees, businesses, developers, researchers

Pricing strategy	Priced for business customer	Free of cost	Free of cost
Platform type & value creation	Close & competitive model	Open & Co-creation& Co-opititive model	Close & co-creation
Critical mass value offering	quality content	Free open source access	Openness, collaboration, quality, transparency
Existence of Value for business customer	Offered	Offered	Offered
Difference in value for businesses customers and consumers	Different	Different	Different and premium for members
Operating cost depends on partners/stakeholders	Supported	Not applicable	Supported
Pricing starts with consumer group	Does not support	Not applicable	Does not support
Sustainable business practice	Observed	Observed	Observed
One target customer group at early platform business	Supported	Supported	Supported when customer becomes member
Trust gain + Risk mitigation	Good governance & transparency + technical capability & maintenance practice	Flexible working process + Crowd auditing private data	Through COC guidelines

Level of interaction	None	Limited	none

Procurement activities such as data procurement is observed in all three urban data platforms. However, the type of procurement differs. In Turku data office, data procurement occurs internally between city domain offices and the data platform. Amsterdam city data is procuring data internally and externally from both internal city offices and external users. Finally, Denmark's open data portal allows registered members only to share data, other than their own internal procurement.

The conceptual model urges the importance of collaborative planning at early stages of data platform development. Result shows that two of three platforms practice collaborative planning (similar as CPFR framework) when specific data demand is made. In other instances, when there is no specific data demand, there is no collaborative planning to publish data. Amsterdam city data, on the other hand, has no such framework to publish demanded data.

To share materials requirement with supplier, vendor management inventory (VMI) is advised so that to keep real time management. The proposed VMI environment is not found in Turku data office. However, in Amsterdam city data such environment already exists. Unlike these platforms, Denmark's portal offers such knowledge sharing environment among registered members only.

Sourced data needs to be clean to publish and quality full and someone inside or outside data platform organization will perform the task. While information regarding data cleaning and verification was not available in Denmark's open data portal, Turku data office is going to outsource the task. Contrarily Amsterdam city data platform performs this task by itself before publishing data.

Interoperability, which is one of the main difficulties in maintaining data platform, has been identified as major establishment component and found be to overcome by the studied platforms. Turku data office uses ready-made integration to integrate multiple database system. Whereas Amsterdam city data uses open source coding throughout their data platform and that of municipal domain offices. Thus, interoperability is avoided. However, information on database integration is not seen in Denmark's open data portal.

The channel of distribution of data and service is the data portal or website for all three data platforms found.

The paper has also tried to see if there is any similarity between data storage and warehousing. It has been found in Turku data office that data is stored by following product management process. Amsterdam city data is storing the source code in Github page for further usage. Similarly, in Denmark's open data portal, data is stored in portal and source code from Github is shared with public.

Consumption of data and thus value creation are fundamental to using data portals for external users. According to the interviewees in Turku data office, consumption of data will take place after users' access API or download data and analyse the data with their own technical capability. On the other hand, based on content analysis on Amsterdam city data, when new product or service innovation is developed using the platforms data, then the consumption of data takes place. Since very limited information is found from Denmark's open data portal, downloading data and getting API access are assumed to be the way of consuming of data.

Customer service is a component of both supply chain management and business model. Therefore, when asked about customer service practice in data platform, it has been observed that service varies in different platforms. In Turku data office, customer service is both automated and face to face. In Amsterdam, customer service means assisting users, developers and researchers to guide to ease the access the resource of the data and its platform. Sharing contents such as use cases with businesses, developers and others are considered as customer service in Denmark open data portal.

Reverse logistics, as practiced by many supply chain managers, was one of the factors in the conceptual model proposed in the data platform operation. Based on the response of interviews and content analysis, reverse logistics is applied neither in Turku data office nor in Denmark open data portal, however, is seen as an opportunity later in the operation in Turku data office. In Amsterdam data, although not found officially, reverse logistics is found through reuse of data by multiple users.

Data administrative model is the ultimate guideline to assess and evaluate management operation in the platform business to secure and stabilize the usage of data. Using open

ended questions, it has been found that each platform has its own form of data governance and compliance model.

All three platforms were analysed thoroughly and interviewed to identify their platform business models. It has been discovered that unlike platform business model standards, in urban data platform, strong customer group is the business customer itself. Denmark open data portal adds internal employees as well to business customers.

While traditional platforms offer their value to business customers for a price, urban data platforms are not charging their business customers. However, only in Turku data office platform is pricing their business customers for downloading data or for consulting service. Both Amsterdam city data and Denmark open data is free of cost. This analysis partially supports platform pricing theory constructed earlier.

Platforms type and respective value creation are two connected factors to understand multisided platform business model. The result of studied platforms varied. Turku data office is a closed platform, and it has a competitive value creation environment. In contrast, Denmark open data platform is closed but offers co-creation to users or partners or members. Unlike other two, Amsterdam is an open platform and creates co-creation and co-opetition environment for both internal and external players in the ecosystem. Therefore, the initial theory of platforms behaviour according to its type supports empirical evidence.

In succeeding platform business, identifying value offering for critical mass is crucial. The value offering of critical mass in data platform has been found different. In Turku data office, the offering is quality content. In Amsterdam city data, the value offering is free open source code and data. Denmark's value offering is numerous such as openness for transparent democracy, quality data and collaborative solution. Thus, it can be said that value offering in data platform model may or not be free, semi-transparent and trustworthy.

The earlier constructed theory on platform operation suggests that having multiple stakeholders or partners into the ecosystem will help reduce platform operating cost. The findings are similar to the construct.

Sustainable platform business depends on platforms ability to create and share value with its internal and external stakeholders/actors in the ecosystem. The aim was to identify whether such business practices are visible in data platform business model. Based on the interview and content analysis, myriad value offering has been found sustainable in different urban data platforms. However, perspectives from stakeholders need to be considered here as well to completely understand whether platforms business practices are creating value for them.

Starting with specific target customer group (specially consumer) will stabilize economic and social sustainability at early platform business. It has been observed in the case of Turku data office that the platform focuses on one customer group primarily, that is business customer. Likewise, both Amsterdam and Denmark data portal also focused on one customer group to start in general. Exception was also found. For instance, Denmark's data portal will commercially consider anyone as customer so long he/she becomes a member paying an amount of money to the platform annually.

Trust and risk in platform business can be gained and mitigated respectively through provisioning resource accessibility and financial value generation (economic sustainability). Good governance and transparency are found in Turku data office's trust gaining strategy, whereas the platform believes, to minimize risk, provisioning technical capability and maintenance practice is the way to go. Similarly, Denmark imposes COC guidelines that talks about all the sensitive issues for both individuals and businesses, especially gaining trust through openness and reducing risk through quality data. Amsterdam city data however offers flexible working process to developers and allows crowd auditing private data to secure trust and risk avoidance.

In short, this research was conducted with intent to discover the latent connections between urban data platform operation with supply and demand mechanisms, along with data platform business model behaviours. Working collaboratively with multiple partners or stakeholders is assumed necessary. The result positively supports that urban data platforms practice or would like to perform collaborative work. Knowledge sharing, through VMI is another fundamental in supply chain world, which is also applied in other fields as well these days. Knowledge sharing, whether through VMI or not, is found to be exist in different forms in different data platforms. Thirdly, urban data platforms have a common approach to interoperability, that is to open source the portal in general. Due to

technical advancement in 2000s, the interoperability barrier is no longer an issue for urban data organizations to muster data from diverse systems. For this reason, interoperability discussion has not been presented in the next chapter. Data platforms business model at early stage development tells that they likely to outsource most of their operations to incur least cost and maximize effectiveness through working with multiple stakeholders. Platforms understand importance of having a governance model for data operation and usually enforces it at early development stage. Business customers are the primary user group, for whom the value is created. Unlike other platform businesses such as Amazon or Uber, the likeliness of business customers not being charged is higher in data platform business model. Close urban data platforms are likely to be competitive to external parties, whereas open platforms offer co-creation and co-opetition. Value offering from different platforms are not same. To reduce operational cost, platforms may work with multiple stakeholders in the beginning of platform development, which also supports outsourcing strategy. Platforms repeatedly talk about value creation with data towards its users although its uncertain if the value is appreciated by stakeholders. Sensitive issues such as trust and risk towards users are also emphasized by platforms. However, depending on the platforms experience and type, the variance in addressing trust and risk varies.

4 DISCUSSION AND MANAGERIAL IMPLICATION

In the last chapter, results from questions and content analysis have been presented through terse description. Pertaining to the findings, detail discussion and author's view point are going to be staged in this chapter. I have presented only significant findings that have answered the research questions, while others are omitted.

Are supply chain mechanisms observed in urban data platform management? What are the key supply chain mechanisms applied in the urban data platform operating model?

The short answer would be yes. First of all, not all supply chain mechanisms are used to develop the conceptual model in chapter 2. Among the chosen ones, only few have a strong effect on the operation of urban data platform. In the following passage, discussions based on results and possible managerial implications are suggested.

PROCUREMENT IN URBAN DATA PLATFORM IS OBSERVED

Typically, procurement activities in urban data platform means sourcing data into the portal. Result from analysis show similar understanding. In an urban data platform, procurement activities are differed due to platforms type and strategic vision. Nascent platforms, to save cost, will procure data and service internally, whereas more experienced platforms might procure data externally. The difference and reason are apparent in Turku data office and Amsterdam city data study, since the platforms are at their different operational phases. Secondly, the task of cleaning and verifying raw data is externalized. As data itself an intangible product, and the service of cleaning is also a task process, it can be said that procurement in urban data platform are of two types: data and service procurement. Thus, managers in data platform business are advised to procure data from internal stakeholders if the platform is a closed system at the beginning. For open platform, managers can procure data from external parties to create an ecosystem. However, it should carefully clean the external data according to platforms administrative model. The task should also be outsourced either by a professional third-party service or controlled crowdsourcing service against an incentive. Putting incentive in this context would enhance user engagement, which is considered as a key metric for platform governance and evaluation.

COLLABORATIVE WORK IS OBSERVED AND STRONGLY SUGGESTED

The earlier conceptual framework endorses the importance of having collaborative action and knowledge sharing in urban data platform operation. Collaborative work such as planning, and forecasting is observed and should be applied in urban data platform operation. All three studied platforms support collaborative cause as well. The goal of establishing a collaborative framework among manufacturing industry is therefore to plan and forecast together and deliver materials to build finished product efficiently. From platform business model standpoint, in many peers to peer platform business, collaboration exists in the form of sharing; some call it collaborative consumption. Examples of such platforms are Uber, Airbnb etc. The objective of these businesses is to find mutual ground between users to share to optimize limited resources and prolong product life cycle. These peer to peer business are nothing but multisided platform business, and collaborative consumption is their business model. Putting this information altogether, since urban data platform is presumed as platform operation that will drive two or more user groups, so, collaborative performance is imperative for urban data platform. It can be called as collaborative consumption or collaborative planning. However, considering ecosystem business model, as multiple interdependent stakeholders will plan collaboratively and distribute tasks among them towards a common goal, this paper identifies the term as "collaborative planning and performance" in urban data platform. However, there may be difference in collaboration procedures. Test result from Turku data office suggests that the platform will work collaboratively only during ad hoc data demand basis. So, even though collaboration is necessary, the usage of collaboration will depend of data platforms organizational mission.

A KNOWLEDGE SHARING ENVIRONMENT IS PRESENT AND MANDATORY FOR SMART DATA OPERATION

knowledge sharing as a supply chain mechanism can be applied in data platform operation. From test results, two out of three urban data platforms are practicing knowledge sharing with their key and registered stakeholders in different forms. Another variable, vendor management inventory is connected with knowledge sharing. Vendor management inventory is a supply chain contextual application where partners in the value chain create a material information sharing environment to manage their operation efficiently. Results suggest that data platform operators facilitate limited or open sharing

environment. For instance, Denmark open data portal allows such support to registered members, while Turku data office does not offer such privilege. The reason for different result may be due platform type such as close or open access to external users, or platforms project scope and insourcing tendency in certain areas. However, opening up the platform for creating knowledge sharing environment was appreciated by the interviewees. Since VMI and knowledge sharing are similar concept, the former is suggested to be replaced by knowledge sharing. Collaboration mentioned in the last passage is also interconnected with sharing environment. Denmark open data encourages users to become member, and only members are allowed to share open data, along with many other facilities. This means knowledge and information sharing across stakeholders is mandatory and cannot be obtained without collaborating with stakeholders. The success of collaboration depends on user's viewpoint of sharing their resources with each other. From supply chain perspective, sharing resources or assets helps improves cost and time management. Dell's approach information to inventory sharing with suppliers is the most viewed example of sharing. Toyota's practice of opening up their internal operation to their partners is another example of sharing. Knowledge and information exchange has even far reaching benefits. One of them is sustainability. When information is exchanged between stakeholders, lesser amount of resource is used for consumption for each user, and thus less waste is generated. The concept "using than owning" will add to retail sustainability (Leismann, Schmitt, Rohn & Baedeker, 2013). Using than owning is achieved when product is used more than once, and prolonged in the life cycle. This can be achieved by moving focus from product-based strategy to service-based strategy, in other words servicitization. This implicates for managers that offering internal data platforms operational knowledge will be a service for stakeholders. Hence a collaborative service sustainable economy can be built in urban data platform business model.

OUTSOURCING WINS OVER INSOURCING IN DATA PLATFORM TASK MANAGEMENT

Both data cleansing and verification are likely to be outsourced by data platform. Considering both scenarios from Turku data office and Amsterdam city data, it can be concluded that close nascent data platforms opt to outsource most of the activities to reduce cost, whereas open and relatively experienced platforms tend to perform core tasks and outsource rest of the tasks. That being said, a future research is needed on the close platform to find if platforms change its outsourcing behaviour to open up later on as it

becomes more mature. Despite all concerns of data cleaning and quality, it has been found that most municipalities won't take responsibility of data being unusable. However, this is only seen in an open data platform where anyone can share data. To tackle this issue, managers should create performance indicators and evaluations for data suppliers. This is one regulation that multisided platforms often practice. Thus, using metrics to limit over access and to ensure quality would help avoid data pitfalls.

CUSTOMER SERVICE IS CORE TO URBAN DATA PLATFORM BUSINESS MODEL

Customer service is a core component of both supply chain management and business model. Customer service is being applied in the transaction process of data operation in urban data platform. Service in urban data platform varies and mostly 'transaction and post-transaction customer service' are observed in the form of allowing access to data and giving support to data seekers respectively. Pre-transaction customer service which usually entails guidelines of customer service in data platform is not seen explicitly. That being said there is chance that customer service guideline has been already included in data platform's data administrative regulation. More primary data based on depth interview is necessary to understand this criterion. Regardless of that, results support Edward Mariens customer service principle of "perfect order" except the right cost and right source of the product. Since the actual valuation of data is not yet understood by data consumers, so there might be diverse opinions on the cost of the data. Likewise, there is no certainty that data suppliers are sourcing data from the right source as the data consumer has demanded against. Once again collaboration is important at early stage of data demand to clearly understand the demand to pass the accurate data in an optimized way.

REPLACE REVERSE LOGISTICS WITH DATA RECYCLING

Now since the data is the central part of this research, putting reverse logistics from supply chain was another intent to simply check its validation in the data platform operation. According to test results, applying reverse logistics of data is complicated to implement. A nicer way to apply reverse logistics for managers would be recycling data. Apart from traditional method, recycling will not start from the final data-based product, rather it will start from the source code or raw data itself. When the same data can be reused for multiple purposes to produce different product or service by multiple users, then recycling

of data will be formed. Thus, storing data as a supply chain mechanism, even it is obsolete, can play an important role here.

Does urban data platform business model behave same as multisided platform business models?

Based on the results, with keeping many factors of platform business model constant (platforms market competition, platform life cycle, level of interaction etc), it can be said that urban data platforms behave like multisided platforms partially. Below is a detail discussion arranged thematically on platforms characteristics. These characteristics were constructed during platform as a business model literature review and can be found in appendices. Majority of the characteristics are observed in urban data platform business model. In addition to discussion, managerial implications are also presented in light of the topic.

BUSINESS CUSTOMERS ARE THE TARGET CUSTOMER FOR URBAN DATA PLATFORM

In a multisided platform business model, consumer is the main customer group with strongest network effect. However, a dissimilarity is found in data platform business model. Businesses, developers or innovators and researchers are the primary and strong customer group for urban data platform. This was expecting. In multisided platform business for instance e-commerce, or a peer to peer platform for instance bike sharing service, the finished product or service is easy to understand and consumable without further processing and complication. In contrast, in urban data platforms, the finished product is usually the data, which cannot be consumed without further processing. An extended analysis on the accessed data can be done with additional time and money investment. Only businesses can thus invest in this for further benefit and innovation. An individual consumer can neither understand the meaning of data nor can buy analytical service to gain insight from the data accessed from data platform portal. Besides, a traditional multisided platform targets consumer to get most out of the network effect that comes with consumer group. Network effect in urban data platform is absent as of this study. This paper thus asks question that whether targeting business customer group would lead to network externality? In addition, whether urban data platforms should shift focus from business to consumers to gain network externality? In general, urban data platforms need to test their current business model first that is marketing towards business

customers. Only after results from first phase of operation, it would understand the need for change or not.

DIFFERENTIAL PRICING STRATEGY IN URBAN DATA PLATFORM BUSINESS MODEL

Pricing of data and service in urban data platform is also coupled with customer type and strong customer group. Platform business model tells that consumers are offered to join the platform for free, however, business customer group is priced. This research has found out that even though on the surface, data is free of cost for all, there are difference in different platforms. Most platforms charge or most likely to charge business customer in future, keeping consumer free of charge as usual. The reason for data being free for all is that municipals are opening up their internal domain aggregated data so that external users can create innovative products and service, which would ultimately benefit citizens life and the city along with it. Despite that valuable data is likely to charged. Also charging is applicable to services as well. Cities like Turku has imposed charge because of data and the domain specific service that they are willing to provide to businesses. As urban data platform is a part of city administration, so the platform is supposed to be public entity. As a public organization, the platform is likely to serve the citizens and individuals based on their data service without charging them. This might explain zero charging policy to consumers since the value of data to consumers is none primarily.

PLATFORMS VALUE CREATION ENVIRONMENT DEPENDS ON PLATFORMS STRATEGY

The environment of value creation that a platform offers is significant to understand platforms unique business model. Initial theory suggests that close platforms practice competitive, and open platforms practice co-creation and co-opetitive value creation environment. Research results also support more or less to such statement. Goal of platform is related to its value creation environment. Amsterdam city data allows everyone to exploit data for the sake of innovation and research throughout the city. The platform does not literally co-create product or service, rather it takes on process and maintenance of resource responsibility so that users can develop on top of it. This paper

has identified such platform as an integrator platform[7]. In addition, cocreation model in Amsterdam takes place between private companies (developers/ innovators) and end consumers or citizens since citizens participate, provide feedback and share their view of need. Thus, this platform encourages users' interactions, whereas in both Denmark and Turku, such interaction between uses has not been found yet. Denmark open data, on the other hand is semi-closed system, where additional benefits can only be obtained through premium annual subscription. This feature indicates a competitive environment. But premium members enjoy cooperation from the platform as in to get assistance in creating value out of the open data. Unlike any two, Turku data office offers competitive environment by monetizing their data and service (as of writing this paper). Each city wants to be unique in presenting their own operating models and to create innovation and city development in corresponding city sectors. That is why such diverse nature of value creation is observed. However, it is important to note that platforms environment depends on its operational maturity. Amsterdam is more mature platform than the others and cares for innovation more, whereas Turku data office is a new platform, primarily focusing on using data to improve business's internal operation. Perhaps the best example is Copenhagen city data, as in the beginning, it had started with an ecommerce portal "Copenhagen city exchange", which had failed to keep promise. Later on, the strategy has shifted from e-commerce to only opening data for free. Therefore, study on platform lifecycle is needed to understand platforms value creation environment in depth.

PRODUCTS AND SERVICES OF BUSINESS USER GROUP ARE THE VALUE OFFERING FOR CONSUMER IN URBAN DATA PLATFORM BUSINESS MODEL

Achieving critical mass through proper value offering is a crucial factor in succeeding multisided platform business model. According to literature review, consumer group is the value offering for business customers and platforms should create proposition to business user group on the basis of consumer user group. However, in urban data platform, the scenario is different due to platforms limited access and seldom interactions between users. Therefore, value offering for business customers here does not revolve

[7] Integrator platform allow external innovators to develop new products and services on the basis of platforms resources.

around consumers rather it is centered around data. Quality content using data is the value offering for business customers and critical mass of this user group is the target for Turku data office. Similarly, the Amsterdam maintains trust of developers by providing intricate open source coding to replicate and assisted working environment. The portal describes the operational process before and after publishing any project or data to any users to maintain internal transparency. In other words, both these examples show that value offering does not involve individual data consumers, rather it involves activities to attract business customers, developers and researchers and thus reaching critical mass of these user group. To conclude, initial literature construct of platforms value offering does not support test results. What is interesting to speculate is that how platforms can reverse engineer to attract consumer user group by using business user group. This will lead to study consumer behaviour and demand to innovation. Because once consumers need and want are understood, developers or business customer group can create new product or service using data. Ultimately developers cannot innovate without consumer insight and consumer are not interested to join platform unless there is enough need-based innovation.

BUILDING STAKEHOLDER BUSINESS ECOSYSTEM IS LIKELY TO REDUCE PLATFORMS OPERATIONAL COST

An ideal platform business model constitutes of having multiple stakeholders with the platform owner in order to reduce operational cost. This characteristic is found in urban data platform in a similar form. Firstly, all of the tested platforms are partnered with limited number of public or private entities, however whether having such partnerships have helped them reducing operating cost or not was not possible to justify. It has been assumed that since urban platforms at the early stage outsource most of its operational activity, so operating cost should be low, even if they are not aware of it or has it not been mentioned publicly. This is where limitation of the study is found. The paper has felt a detailed “stakeholders analysis” to understand stakeholder’s perspective of task sharing to optimize operational efficiency. Based on this analysis, a rational step for managers would be to incorporate “value adding partnership” into partnership domain of business model, since such supply chain strategy would help gain a low overhead cost. Moreover, in this partnership, each stakeholders control and sustain other business practice, and thus sustainable business practice can also be monitored.

URBAN DATA PLATFORMS INTEND TO OPERATE SUSTAINABLY

One major characteristic found in platform business model is that sustainability which is achieved when the platform creates value for both internal and external actors or stakeholders in the ecosystem. Moreover, sustainability also means activities that are performed to sustain positive and natural environmental changes. Sustainable business practice can differ in data platforms. Some platforms create sustainable value to internal actors by sharing data for improving city operations. For instance, Turku data office shares data with their domain and administrative offices. Others like Amsterdam shares value to business partners through flexible working environment for innovation. This platform also enables end user/ consumer communication directly towards innovators in the platform, thus sustainable value for external users is also observed. For Denmark open data, sustainable business practice is for internal actors such as employees first to gain transparency in administrative office and then to external stakeholders by applying code of conduct in data driven growth across cities in Denmark. Similarly, each smart city envisions to build environment-friendly innovations and development. For instance, the "Smart and Wise Turku" project aim includes carbon neutrality for environment, social exclusion for improving healthy living and so on is another indicator of platforms performing their practice environment friendly. On the basis of this analysis, urban data platforms, through practicing sustainability, operate as multisided platform. A future research on urban data platform sustainability on their operational process using value adding partnership (VAP) to see if earlier suggested VAP is being followed or otherwise. Because according to this research review, sustainability is achieved by sharing value, which can be accomplished through governing stakeholder's actions in the operational ecosystem. Interestingly "value adding partnership" (VAP) is based on same ideology where partners work towards a common goal and control and monitor each other's business practice.

URBAN DATA PLATFORM FOLLOWS MULTISIDED PLATFORM BUSINESS MODEL IN TARGETING ONE CUSTOMER GROUP INITIALLY

To gain economic and social sustainability, multisided platforms start marketing with one customer group only. Analysis on three different urban data platforms support this behavior. Two of three data platforms studied has focused on only one side of the user group, the group who would more likely to access platforms data and use it for innovation,

research or create product or service. Individuals, who are the other user side, do not count into this group. Turku data office plans to gain economic sustainability through monetizing demanded data and providing domain service to business customers, whereas social sustainability is gained later when the project vision is accomplished. Similarly, Amsterdam city data plays a passive role to accomplish economic and social sustainability. They welcome developers, researchers to study and exploit data in order to improve the city's economy and environment through innovative product and service. However, there is exception. Denmark open data portal does not focus only on specific customer group, rather they consider any user group so long that particular user becomes a premium member by giving an annual fee. Economic sustainability for Denmark data platform is gained through premium members. This result also coincides with data platforms strategy of value offering to business user group only. Thus, it can be said that past research on platform business model of economic and social sustainability is valid in urban data platform operation as well. Focusing on one customer group may mean that platform will limit access and or interaction to other user groups, which can be considered ok in multisided platform business. For instance, before making Facebook public to everyone in 2006, it had only allowed universities (one user group) to join the platform (Stutzman et al. 2013 cited in Hein, A., Schreieck, M., Wiesche, M., & Krcmar, H. (2016)). Once public, the user growth had become massive. Therefore, it can be said that to foster and expedite user growth in platform business at certain timeline, urban platforms should promote them to one side of the users only, that is the group of business, researchers, developers etc. It would even be more intriguing to conduct quantitative research on two factors: user/customer growth and platform lifecycle to identify at which stage platforms should allow more users into the platform.

TRUST AND RISK ARE HIGHLY PRIORITIZED IN URBAN DATA PLATFORM BUSINESS MODEL

Platform business model emphasizes on trust and risk issues and how these should be tackled. As constructed in literature that resource accessibility and financial value generation for users will help gain trust and mitigate risk. It turns out urban data platforms act similarly, though the terminologies used to address trust and risk differs in different platforms. For instance, in Turku data office resource accessibility is done with transparency, meaning opening internal operational process to external users. Good governance that makes favorable business decisions to stakeholders will also add in

gaining trust. They want to minimize risk by replacing monetary benefits with sharing technical capability and maintenance practice. Similarly, Amsterdam gains developers trust by providing flexible and ready-made working environment to use open source code. In addition, it attempts to reduce risk by allowing peer auditing project data quality, which in turns creates transparency. Denmark open data shows similar behavior where trust and risk are addressed with in-house transparency, data driven growth and data portal association's COC guideline. It can be deduced that data platforms that share open data, replace their stakeholders financial value generation for trust with accessibility, technical support, supportive policies etc. Even though there aren't any monetary benefits involved while being involved with platform, business users or developers can still exploit the platforms internal resource and data to further produce commercial goods and services.

5 CONCLUDING REMARKS

To achieve thesis research goal, I have studied three diverse domains: urban data platform, platforms business model and supply chain management. I have also build up a conceptual model of urban data platforms operation using supply chain practices. I tested the model on three real urban data platforms to justify the model's practicality and learnt new findings on urban data platform business modality. On the basis of results and discussions from last chapter, I can safely conclude that supply chain practices, as studied, applied and tested using the concept model, have been implemented to the operation and business model of urban data platform.

Due to lack of basic research on urban data platform mechanisms in the past, this paper has contributed to research field by identifying the key pillars of successful urban data platform organizational operation. These pillars, in a deeper context, are supply chain activities such as "collaborative planning and performance" (collaboration between partners or stakeholders), "knowledge sharing among the partners in the value chain", "outsourcing tasks", "data and service procurement", "customer service", and "sustainability"- all of which are observed and have been employed in urban data platform operation.

On the surface level, supply chain, data platform operation and platforms business modality are intertwined. For instance, supply chain is defined as a flow of information (which is a thoughtful version of data), raw materials (datasets) and finished goods (service based on data) from supplier (anyone including city offices as internal user, and businesses, researchers, individuals as external user) to manufacturer (the urban data platform who process or accumulates the data and produces data services) to retailer (the external users such as business, researchers and others who would further process data and sell their own product and service). This creates a chain of key partners/ stakeholders whom would work together, which is emphasized in both supply chain and platform business model. In addition, this paper has proved that urban data platform partially operates like multisided platform business model.

However, I speculate two major components that either were not considered at all in the studied platforms or have failed to shed enough light for managers of data driven organizations. First one is data usage for cities internal operation. Each municipal has its

own vision that complies with smart city objective to address urbanization. To achieve city centric vision, data driven 'performance and city service' is unavoidable. Second one is the realization of data usage or the actual value of having raw data at hand. Even after getting access to (open) data, many are uncertain of its proper valuation and utility due to limited number of use cases. Therefore, data supplier or data facilitator should voluntarily develop "data-based meaningful value offering" to the interested parties. Considering these missing points, other than already highlighted pillars in urban data platform operation stated earlier, I would like to share my recommendation to practitioners in both public and private sector:

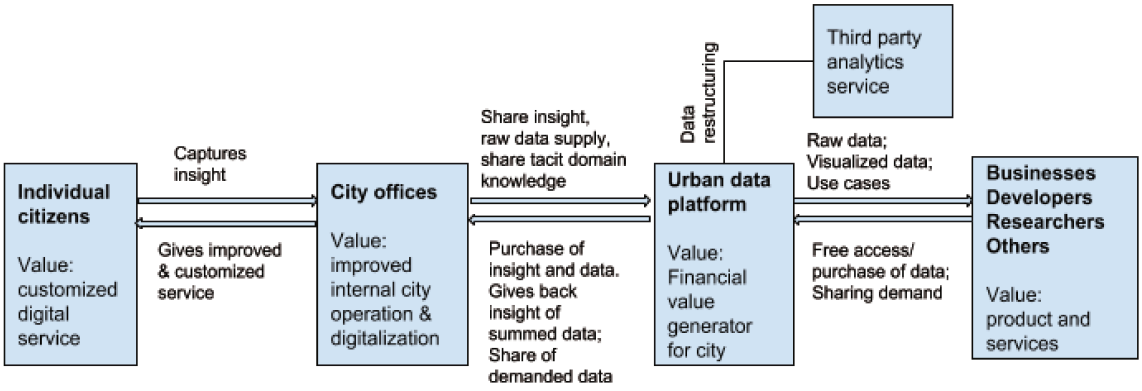

Figure 6 An ecosystem of circular economy of data in urban data platform

Urban data platform should act as intermediary and contain two data-utilization scopes: one that focuses city operation and service, and two that focus on publishing public data (both demanded data and periodical data). Both scopes will operate side by side, will complement and depend on each other. First, major public entities, city data platform, and key private parties as stakeholders will collaborate on open data initiative planning and performance. Second, since public offices are already providing services to citizens, they are receiving large amount of citizen/consumer data. The city will trade off these public data with urban data platform. Third, the data platform will develop visualized meaning of data and/or create use cases from data. Remember that the data platform is originally sourcing raw public data from city offices and should restructure the data into insights with or without help from third-party service. Outsourcing the data restructuring task (includes both data cleaning and verification) will create a business ecosystem. Finally, the platform will trade off visualized data or use cases to private parties. Sharing use cases as value offering than raw data will help interested parties interpret the value of the raw data pertaining to a use case. Following such steps will create a circulation of data

throughout the entire urban data ecosystem. Type of trade off will depend on contractual agreements and knowledge sharing environment between stakeholders and should be devised at early stage of collaboration.

While undertaking this research, I have faced with several limitations that may or may not affect the overall result or discussion of the research questions and objective. The research was undertaken on only three urban data platforms: Turku data office (closed platform), Amsterdam city data (open platform) and Denmark open data (Semi-closed platform). However, there are numerous other types of urban data platform in smart city project around the world. Each has its own technique of representing their data platform. Therefore, unless a thorough study on each of them has been performed, generalizing on urban data platform operation and its model would be unwise. This is one of the limitations of the research. In addition, municipals are developing data platforms to publish both static (data that are coming from municipal offices) and dynamic data (data coming from sensors, devices and social media). The latter data is crucial in understanding urban dynamics, which in turn helps to eradicate urbanization barriers economically, socially and environmentally. However, dynamic data is omitted here considering research and project scope. Thus, it might question the justification of conceptual models developed. This is also considered another limitation of the paper. Many important factors such as platform lifecycle, level of interaction between users in platform, platforms external market competition etc were not included in the analysis of urban data platform business model. However, the existing thematically presented discussions in the last chapter suggest the importance of aforementioned factors as they are connected to the business model as a whole. So how these discarded elements are influencing the researched elements overall is another question to ask. An investigation on urban platform business model from business perspective rather operational might overcome this limitation.

During content analysis, it has been observed that although each data platform emphasizes on citizen participation and bottom to top approach of communication, limited or zero actions facilitating consumer/citizens voice raised against a specific project or dataset throughout urban data platform interface are found. If supply and demand, both terminologies are considered into the context of urban data platform, there should be enough facilities for citizens as consumers to share their thought on received city service

or a demanded product or service from a private organization. Also, all platforms currently focus on business user group of the multisided urban data platform and have presumably ignored the network externality possibility. Therefore, future research on consumer user group and their value creation in urban data platform would help all stakeholders associated with platform operation. As urban data platform only partially behaves as multisided platform; it could be said that urban data platform is not a platform, rather a pipeline operation. That being said, future research on conversion from pipeline to platform business model for urban data platform would create new insight for cities with same initiative. It would even be wise to study urban data platform on the basis of pipeline model first to gain deeper knowledge. Since cities are converting them into smart cities, how opening up governmental data is making a difference to the overall vision of sustainable smart city would be another field of research. In that regard, future research can entail innovative approach to achieve sustainability in digital world and measurement of city performance in open data initiative. Finally, the highly emphasized “collaboration” effort can be achieved with proper marketing efforts. Marketing research towards business and citizens on data utilization coming from semi-independent urban data platform organization can be another future research direction.

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APPENDICES

Open ended test questions:

1. Do you have any procurement activities in your platform operation and if so, what are those?
2. Is planning and forecasting of data demand done entirely by your platform or do you work collaboratively with other stakeholders? If so, who are these stakeholders? And what framework does your platform follow for planning and forecasting data demand?
3. In supply chain context, 'vendor management inventory' is a modern technique to manage demand with supply, where suppliers are direct contact with retailers instead of manufacturers. Does your platform offer such environment? If so what kind of knowledge sharing activities does your platform facilitate?
4. Data cleaning and verification are important in data veracity. Does your platform perform these activities, or do you outsource it?
5. Who are your platforms data supplier?
6. What are the processes of identifying data sources? And how (technological capacity and capability) do you capture raw data?
7. How have you overcome the interoperability issue (integration of different database systems)?
8. Is there any definitive production process of manufacturing datasets and services from raw data? If so, who performs this task?
9. What is the channel of distribution of final products (datasets and services)? What is the distribution process for service?
10. Do you store data for future use?
11. What activities your customer does to consume data?
12. What features your platform distribution channels have to facilitate the consumption?
13. What customer service your platform offers to your customer?
14. Have you ever applied concept 'reverse logistics' in retrieving datasets back from customers? If so how do you perform and what data do you retrieve?

15. Is there any 'data and platform governance model' standard in your platform operating policy? What are they? Does the policy address, privacy, trust, risk, security and transparency, and abide by external regulations (such as GDPR)?
16. How many users (consumers and business customers) does your platform have at present?
17. Which user or customer group is stronger in terms of having network effect? How is the pricing for this group?
18. Is your platform open or close? If open, what value proposition your platform offers to external actors and how is the interaction level for internal actors? Describe briefly the same scenario in it is a close platform.
19. Is value offering from the platform towards its user free, transparent and trustworthy?
20. How does the platform intend to reach critical mass?
21. Does your platform offer value proposition to business customers?
22. Is value proposition same for both type of customers or is it different for business customers? If so what is the difference?
23. In what stage (lifecycle) your platform is at present? When is the estimated time of scaling up your platform into next phase? What are the reasonings for that?
24. How many platform business partners/networks/stakeholders are there involved with your platform?
25. In what way having such partners in your platform operation is improving your business? Has your platform experienced any cost reduction as a positive impact of having multiple business partners/stakeholders?
26. Do you charge both consumers and business customers? Whom did you charge first?
27. How do you respond to multihoming if it is present in your platform?
28. How do or would you exploit single homing to sustain competition?
29. Do you hold your business partners accountable for sustainable business practice or vice versa? Does your value proposition include sustainability?
30. Which customer group you have targeted first to gain economic and social sustainability?
31. What are the main activities that you perform to gain trust and reduce risk of consumers and business customers?
32. Shortly describe the metrics of level of interaction between users in your platform.

33. The number of network in open platform ecosystem is high at birth (start) stage and low at renewal stage or vice versa for close platform. Do you agree with above statement: True or false?

Constructs developed on platform as a business model

- Construct: number of user (consumer and business customer) in platform depends on network externality.
- Construct: the user group with strong network effect is likely to be excused from pricing
- Construct: open platform welcomes value co-creation and co-opetition to external actors and expedite interaction for internal actors/innovators/developers.
- Construct: Close platform creates competition in external market, while limits interaction for internal users
- Construct: in order to reach critical mass, value offering must be free (in early stage development, if business environment is static), transparent and trustworthy.
- Construct: Platform should create value for business customers. Critical mass of consumers is the value proposition for business customers.
- Construct: Platform should only scale their business up once they have reached optimal number of users (critical mass) and interaction.
- Construct: the more the number of partners/stakeholder is, the less the platform operating cost.
- Construct: pricing formulation starts with investigating consumers first instead of business customers. (contradicts with data platform as TDO focuses on business customers only at present)
- Construct: When multihoming is present, focus on investing on users whom are single homing
- Construct: To increase the intensity of competition in platform business, drive and foster single homing (focus on how and what to impose that will create single homing)
- Construct: sustainable platform business depends on platforms ability to create and share value with its internal and external stakeholders/actors in the ecosystem
- Construct: Starting with specific target customer group (specially consumer) will stabilize economic and social sustainability at early platform business.

- Construct: Trust and risk in platform business can be gained and mitigated through provisioning resource accessibility and financial value generation (economic sustainability)
- Construct: the level of interaction of platform will create network effect
- Construct: The number of network in open platform ecosystem is high at birth (start) stage and low at renewal stage (later)
- Construct: the number of network in close platform ecosystem is low at birth stage and high at later stage.

Variables developed from literature

1. Network externality and cross externalities.
2. Platforms internal and external actors' participatory relationship and platforms openness (independent variable)
3. Optimal number of users (critical mass) and scaling platform service
4. Value proposition (independent variable) and critical mass (dependent variable)
5. Platform operating cost and platform partners
6. Pricing strategy and target customer
7. Multihoming (Cause) and competition (effect) in platform business
8. Sustainable platform business and shared value internal and external stakeholders
9. Platform governance (operating and resource structure) and social & economic sustainability
10. Platform performance metrics

    Metric 1: interaction level (To what extent users are allowed to engage with each other)

    Construct: users engagement will define the possibility of repeat transaction

    Metric 2: Repeat transaction standard (how many repeat transactions need to occur to make platform successful)
11. Platform growth can be characterized by type of industry, its strategy and interaction frequency