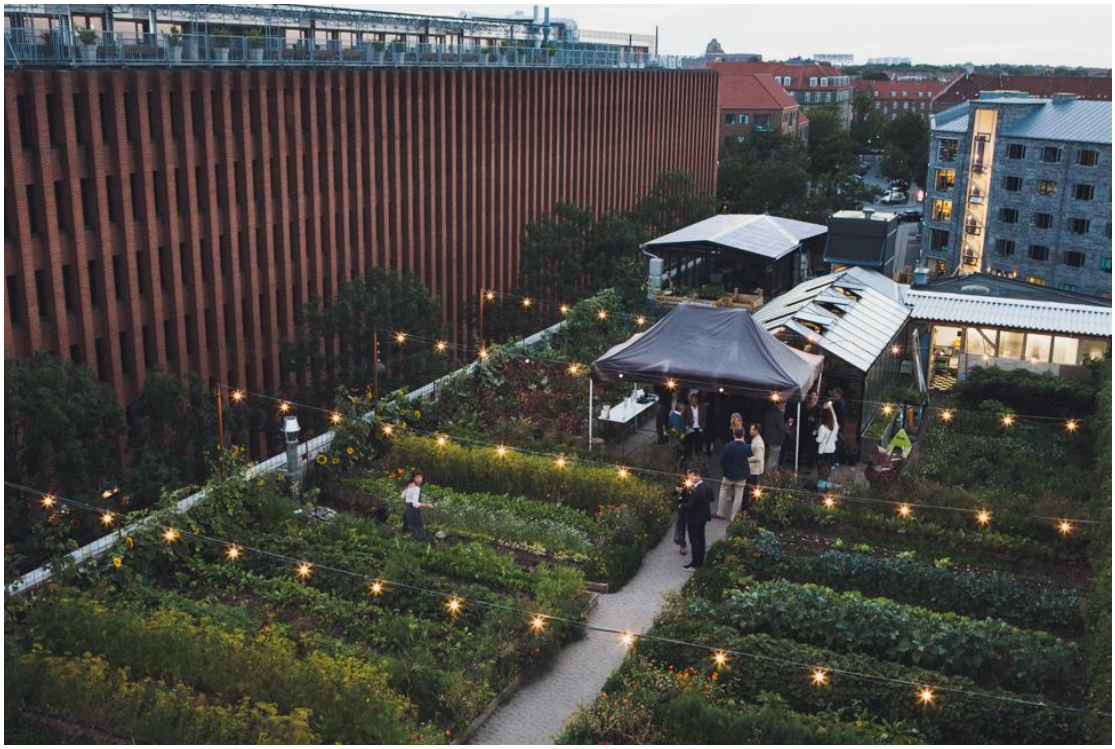
A Stakeholders' Perceptions Study of Rooftop Farming Development in Shanghai

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Abstract

Rooftop farming is a new concept that gains increasingly concerns by urban planners in recent years. As a type of urban agriculture, rooftop farming provides a different strategy to develop urban agriculture in the conditions of land resources scarcity. Rooftop farming is a possible solution to address the contradiction between the strong demands of food production and limited land resources because rooftop farming does not occupy any traditional land resources. In this paper, rooftop farming in Shanghai is researched. Through the investigation of relevant stakeholders of rooftop farming in Shanghai, their perceptions and acceptance towards rooftop farming are concluded as results. The main result is more stakeholders think rooftop farming is a social tool rather than a food production initiative. Therefore, the educational and social benefits of rooftop farming are concerned by more people.

Keywords: rooftop farming, urban agriculture, perceived benefit, perceived risks, perceived contextual factors

Summary

Rooftop farming seems a possible solution to address the potential food production problem and land scarcity problem. There are some researches concerning rooftop farming, however, researches about rooftop farming in China are very rare. Therefore, the research regarding rooftop farming development in China will fulfill the knowledge gap in rooftop farming studying.

In this paper, Shanghai was selected as a case study because the rooftop farming here was developed earlier than in other cities. In Shanghai, the useable vacant rooftop area is in a large number, but the amount of rooftop farm projects is quite limited. The word ‘rooftop farming' has never been mentioned in official documents. All these facts show the development of rooftop farming in Shanghai is still at a very early stage. In this introduction stage of rooftop farming, the perceptions and acceptance of relevant stakeholders will largely affect the success or failure of rooftop farming development. Thus, the research objective is to investigate relevant stakeholders' perceptions and acceptance towards rooftop farming in Shanghai.

In order to realize the research objective, the conceptual framework and research methodology were identified. The conceptual framework referred to the ‘acceptance theory’ formulated by Lucke (1997), which also was used by Specht et al.,(2016) in their research on the stakeholder perception study on rooftop farming in Berlin. The ‘acceptance theory' is structured as three elements: subject of acceptance, object of acceptance and contextual factors, which means stakeholders' general attitude, perceived benefits and risks and perceived promoting and hindering contextual factors. Following the conceptual framework, the specific research questions were formulated and the results of the research were also presented from these three aspects in this paper. The research methodology of this paper is the case study approach. Aiming to get enough useful date, semi-structured interviews and document analysis were implemented in the research process.

In the results section, the answers of the interviewees in Shanghai were concluded. Their general attitude towards urban agriculture and rooftop farming were divided to two groups, a part of stakeholders think urban agriculture and rooftop farming should be a social and educational tool, however, the other group of stakeholders prefers to acknowledge their food production function. The most important three perceived factors are education benefit, greening benefit and huge education demand market promoting contextual factor. At the end of this paper, the findings of this research were also compared with other researchers' findings in the international context. The main similarity in two cases is more stakeholders think social function of rooftop farming is more obvious, and the main difference is factors related to food sales are missed in this research because the legal framework of sell food product is stricter in China. At the end of the paper, the societal recommendations are given to the government. Government is suggested to provide more political help for other rooftop farming initiators.

1. Introduction

1.1 Background

With the rapid urbanization spreading in the global range, more and more urban issues emerged. On the one hand, urbanization brings a series of environmental problems, for instance, low air quality, UHI effect, high energy consumption and stormwater runoff control. Ideally, a sufficient amount of green area is needed to enhance the urban ecological and environmental performance (Xiao et al., 2014). On the other hand, the growing urban populations are facing the problem that how urban residents are fed. Besides that, the large food footprint, low food sufficient rate, and food security are getting more attention. In order to address and mitigate these complex urban issues, urban agriculture is considered as a possible initiative due to its urban greening and food production functions. As what Hodgson et al. (2011) defined, urban agriculture becomes a feasible solution to improve cities' self-sufficient capacity, enhance the resiliency of food supply, and bring many co-benefits such as, extra economic benefits, improvement of local environment and more abundant landscape types.

However, a high degree of urbanization also leads to the scarcity of the usable land resources for developing urban agriculture and urban greening. In this situation, as an integration of urban agriculture and green roof, rooftop farming has become a potential solution to improved urban food production and broadens city greening area without occupying conventional land resources(Ackerman et al., 2014). As a special type of green roof, rooftop farming also has similar functions as the green roof. For instance, green roofs could not only effectively contribute to mitigate urban heat island effect and improve building thermal performance and reduce energy consumption (Kumar and Kaushik, 2005, Niachou et al., 2001, Santamouris, 2014), but also help improve air quality and manage stormwater runoff (Yang et al., 2008, VanWoert et al., 2005). For its food production and commercial practices, a number of successful examples have already been implemented in the global north. For instance, ‘‘Lufa Farms" (Canada), ‘Gotham Greens" (USA), ‘‘Brooklyn Grange" (USA), and ‘Urban Farmers" (Switzerland)(Hui, 2011).

Shanghai is a huge-scale and highly urbanized city that is also facing the urban issues mentioned above. In 2015 there are about 2000 hm2 vacant roof area are suitable for green roof retrofitting in Shanghai, but only around 200hm2 rooftops are covered by green plants (He et al., 2016). Green roof construction in Shanghai still has a great potential to develop in the future. However, in the situation of limited development of green roof, rooftop farming, as a kind of green roof, is in a poor development in Shanghai, and only a few cases are implemented in Shanghai by private companies. Even in the document of the Shanghai green roof policy and Shanghai urban agriculture planning, rooftop farming never is mentioned, which suggests the rooftop farming

development in Shanghai is still remaining an early stage and the broad introduction of rooftop farming has not been performed. All the facts reveal a societal problem: in terms of spatial condition, Shanghai has enough availability to develop rooftop farming, however, it poorly developed here. Therefore, it is unclear what are reasons that postponed or hindered development of rooftop farming in Shanghai. Before an innovation is well introduced and widely spread, the perception and social acceptance of rooftop farming, are important preconditions for the success or failure of its diffusion (Specht et al., 2016, P.755). The perceptions of the powerful relevant stakeholders who may contribute to the rooftop farming will influence the phenomenon of rooftop farming development. Therefore, in the rooftop farming development context of Shanghai, a research regarding the potential perceptions and social acceptance of the stakeholders is needed to predict whether rooftop farming can be introduced successfully.

1.2 Problem description

There are a few studies regarding stakeholders' perceptions of rooftop farming topic could be found, but most of them are focused on Barcelona and Berlin cases. An overview of these researchers' studies was presented in Figure.1 below, including the authors' name, topic, research content, indicators and cases they studied.

Through the overview other researches, it shows that the similar points of these papers are they all studied the benefits or risks of rooftop farming, but the indicators they selected are slightly different. It gives me an inspiration that the benefits and risks study are the commonly used research content in the studies of perception on rooftop farming. And the indicators they chose also help me to identify the indicators in my research. However, there is also a limitation in these studies. These researchers mainly focused on Berlin and Barcelona, these two case cities, and most of relevant literatures are written by Specht, Sanyé-Mengual and their groups. The limited cases studies and the inherent thoughts from the same authors may result in the limited understanding towards rooftop farming issue, because in other context, for example in China, the perceptions of stakeholders may be different from the international context. So, the scientific problem is stated below:

There is a lack of knowledge concerning perceptions of relevant stakeholders who have powerful impacts on rooftop farming development, such as in the context of China.

Authors	Topic	Research content	Indicators	Case
Cerón-Palma et al. (2012)	barriers and opportunities study in the implementation process of rooftop eco greenhouse (RTEG) in Barcelona	Barriers and opportunities of RTEG and stakeholders' perceptions of incorporating RTEG according to three different urban building typologies	environmental, social and economic aspects multi-family residential buildings, education and cultural buildings, and industrial buildings	Barcelona
Sanyé-Mengual et al. (2016)	relationship between stakeholders' perceptions of urban agriculture (UA) and urban rooftop farming (URF)	stakeholders' perceptions toward opportunities (benefits), barriers (risks or challenges) of rooftop farming and stakeholder's perceptions of UA, discussed the relationship between the stakeholders' definition of UA and the development of URF	environmental, technical, social and economic aspects	Barcelona
Specht et al. (2015)	aggregated stakeholder perspective on its potential benefits and challenges of ZFarming	stakeholders' perceptions toward opportunities (benefits), barriers (risks or challenges) ZFarming. And perceived contextual factors	environmental, technical, social and economic aspects	Berlin
Specht et al. (2016)	perception and acceptance study of ZFarming in Berlin	stakeholders' perceptions toward opportunities (benefits), barriers (risks or challenges) of ZFarming.	environmental, aesthetical, social and economic aspects	Berlin
Specht and Sanyé-Mengual (2017)	compared the risks of rooftop farming in Berlin and Barcelona through investigating stakeholders' perceptions	focusing on perceived risks of rooftop agriculture	urban integration, production system, food product, environmental and economic aspects	Berlin and Barcelona

Figure.1 Literature overview (self-made)

1.3 Research objective and research questions

The purpose of this research is to investigate the stakeholders' perceptions towards rooftop farming development in China. Through the academic research, I'm aiming to figure out the perceptions difference between different types of stakeholders, and truly present the perceived opportunities and risks of rooftop farming in China drawing from various stakeholders'

perspectives. The research results are expected to fill the scientific gap of lacking relevant academic research regarding stakeholders' perceptions of rooftop farming in the context of China. The expected findings of this research are helpful for spatial planners have deeper understanding of rooftop farming issue, and it may bring planners a new inspiration and possibility to properly use vacant space on rooftop. The main research objective is summarized and formulated below:

The main objective of this thesis is to analyze the stakeholders' perceptions and social acceptance of rooftop farming development in China to identify the perceived opportunities and risks of involved stakeholders.

According to the research objective, main research question is formulated as:

What are the perceived opportunities and risks of rooftop farming development in China?

In order to explore and answer the main research question, several sub-research questions are needed to cover all of the components of research. The sub-research questions are structured based on the theoretical framework of this paper; thus, they will be illustrated in the next chapter.

2. Theoretical framework

2.1 Definitions of urban agriculture and rooftop farming

The definitions of urban agriculture are a bit various from different time and different researchers. The most commonly agreed definitions of urban agriculture are from Smit et al. (1996) and Mougeot (2000) (Specht et al., 2014). Smit et al. (1996)'s definition was recorded by United Nations Development Programme. They defined urban agriculture is an industry that produces food, makes food and sells food. The meaning of urban agriculture is mainly to fulfill the basic food demand of consumers in the areas of a city or metropolis, on land and water spread in urban or peri-urban region. Mougeot (2000) changed the definition a little. He thought urban agriculture is an industry within city or on the fringe of a city, which produces, processes and allocate various food and non-food products. Besides that, he thought the definition of urban agriculture should also include the process of reusing human resources, goods, and services that found in the urban and peri-urban regions and resupply and redistribute these resources or service largely to urban area. In this paper, the definition of Mougeot (2000) is considered as the common academic definition, and the definitions of interviewees will also be presented in Results chapter.

Rooftop farming is a newer concept that urban agriculture. Mok et al. (2014)said urban rooftop farming is occurring throughout cities, as a result of people are more and more interested in urban agriculture. The definition of rooftop farming mostly come from recent five years. New York City Council (2012) has included rooftop farming in the urban planning policy and defined rooftop farming as a type of urban agriculture that located on the rooftops of buildings. In Specht et al. (2014) 's research, they defined rooftop gardens and rooftop greenhouses as types of 'Zero-acreage farming'(ZFarming), which is a kind of urban agriculture that does not use farmland or open space but locates in or on buildings. According to the definitions of other researchers, they all think rooftop farming is a type of urban agriculture, therefore the study of rooftop farming should be linked to urban agriculture as well.

2.2 Perceptions of rooftop farming in other researches.

Due to different research objectives, findings of other researchers also drew various conclusions in their papers. Cerón-Palma et al. (2012) found that the RTEG system on multi-family residential buildings can bring sociability between neighbors in the community, and RTEG on educational and cultural buildings can play a role of environmental education tool. However, RTEG on industrial buildings is facing a large barrier that industrial buildings rooftop are usually made by light mental structure that's not enough for holding the extra installation. Sanyé-Mengual et al. (2016) concluded that the main driver of UA in Barcelona is addressing

social needs instead of improving food production. However, the stakeholders who encourage URF state that the URF is an effective tool to improve the urban food production function. Therefore, the researchers believe altering the driver of current UA projects into productive UA is the way to promote URF development. Specht et al. (2015) summarized most stakeholders agreed that local resources, low energy production, positive social and educational benefits and creating of new market structures should be the emphasis of the potential ZFarming development, which will be helpful to avoid the risks and make full use of the advantages of ZFarming. In Specht et al. (2016, P.767)'s study, they found the perceived benefits and the factors promoting social acceptance mainly include 'educational programs, community building, the improvement and establishment of resource cycles within the house or neighborhood, and the exploitation of local resources'. And they identified the main perceived risks as health risks, the risks of soil-less planting technology, urban animal production and the conflicts to conventional perceptions of agriculture. They believe these factors could result in the promotion or obstruction of the new innovative projects at the beginning. Furthermore, through the comparison, Specht and Sanyé-Mengual (2017) found there are few differences in risk perception between the two cities. The perceived risks of both cases are related to the lack of knowledge, fragmental policymaking, poor communication with the public and the lack of operation demonstration.

2.3 Theoretical framework used in other researches

Through literature overview, I find researchers used various theoretical framework to structure their academic study. For instance, Sanyé-Mengual et al. (2016)'s analysis focused on stakeholders' 'perceptions, conceptualizations, and drivers'. The perceptions mean perceived opportunities or risks concluded from stakeholders experience, viewpoints, and stories. Conceptualizations represent the particular definitions that how stakeholders define different elements and systems, in this case, it is stakeholder's definition of UA. Drivers mean the motivation and objectives that promote the development of this project. Specht et al. (2016, P.755,756) developed its analytical framework based on the book on 'acceptance" edited by Lucke (1997). In this paper, the authors followed Lucke's understanding and conceived of 'acceptance as the result of an interrelated decision-making process that depends on the subject of acceptance (stakeholders), the object of acceptance (in their study: perceived factors of ZFarming) and the respective context' (Specht et al., 2016, P.755). Firstly, the subject of acceptance in their case means the individual stakeholder involved in their analysis. In practice, they explored the interviewees' individual basic information, such as skills and expertise and asked their general opinions toward ZFarming. Secondly, the object of acceptance means related acceptance of ZFarming in their case. Here, they investigated benefits and risks factors influencing ZFarming development. Thirdly, Specht et al. (2016, P.756) stated 'the acceptance

or rejection of ZFarming depends on a set of framework conditions. Such contextual factors shape the environment in which the acceptance process occurs. Important context factors include the political context (e.g. political programs, mainstreams), legal frameworks, the market situation, the spatial context, social processes (within groups of actors or organizations, trends) or features of the innovation process itself (such as opportunities for participation).' Their analytical framework was illustrated below (Figure. 2). In addition, Specht and Sanyé-Mengual (2017) also used the concept of 'social acceptance' in their study.

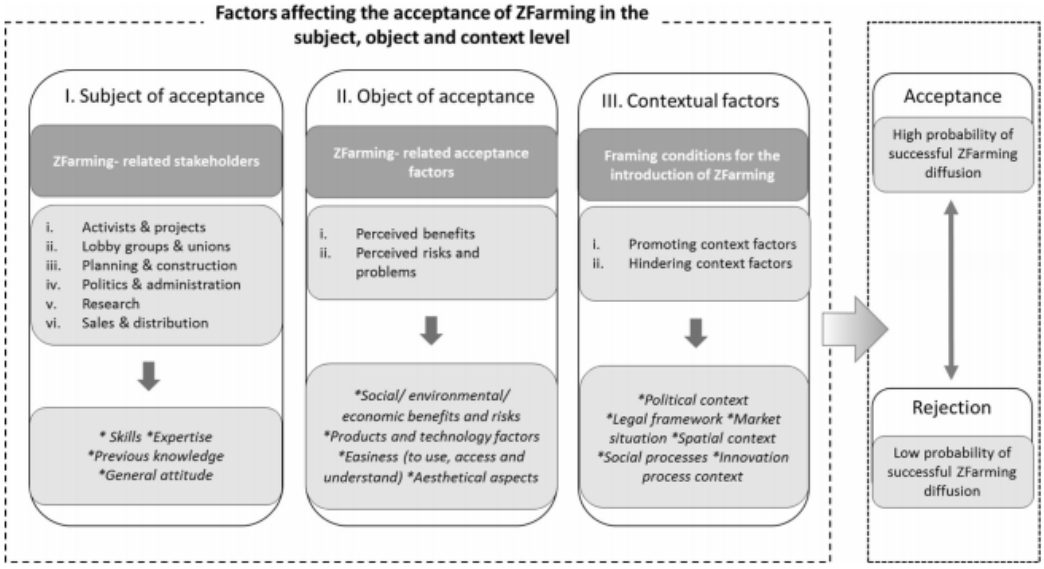


Figure.2 Analytical framework of 'factors affecting stakeholders' acceptance or rejection of ZFarming are analyzed at the subject, object and context levels' (Specht et al., 2016, P.756) (based on Lucke (1997))

2.4 Theoretical framework of this research

The relevant literatures listed above applied different approaches or theories due to different study objectives and contexts. In Cerón-Palma et al. (2012)'s research, the perception of stakeholders study is just one of elements of their research and they didn't use the specific theory as the basis of their study. Nonetheless, they considered stakeholders' perceptions towards different building typologies as a research element. In Sanyé-Mengual et al. (2016)'s study, their main goal is to understand how the perception and definition of UA shapes the development of URF through investigating the stakeholders' perceptions of UA and URF. They are trying to figure out the relationship between the UA and URF. As the development of rooftop farming in Shanghai is still at a very early stage, the 'acceptance' theory used in Specht et al. (2016)'s research is more suitable for Shanghai. On the one hand, the rooftop farming is not widely applied in Shanghai and not included in neither Shanghai's green roof policy nor Shanghai's urban agriculture planning, and

there is no relevant research studying this topic. Thus, the investigation of the social acceptance and perceptions of the potential stakeholders is useful to assess the success or failure of rooftop farming development (Specht et al., 2016). On the other hand, investigating and understanding the factors influencing the acceptance or rejection of the rooftop farming is helpful to create a better phenomenon to promote rooftop farming development (Specht et al., 2016). In summary, the theory regarding social acceptance issue developed by Lucke (1997) and applied by Specht et al. (2016) in their rooftop farming research is more suitable for the context of China. Moreover, the study of stakeholders' perceptions towards UA are valuable to be integrated in this research to make it more comprehensive. The theoretical framework of this paper is presented in Figure.3. The particular stakeholder group composition of this study will be identified in the field work. The stakeholder group should conform to the context of China.

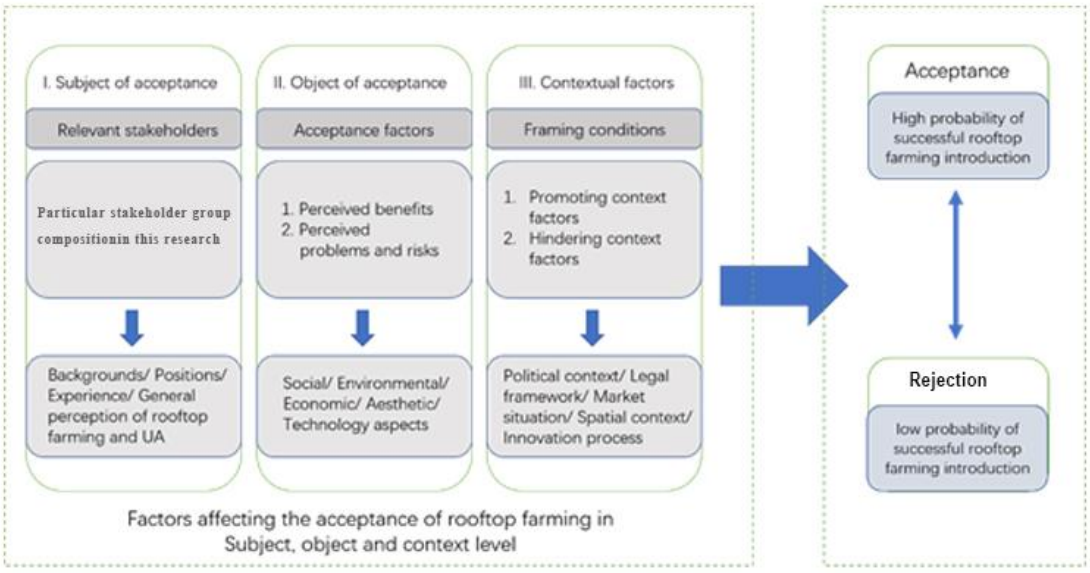


Figure.3 Analytical framework of the thesis (self-made)

2.4 Sub-research questions

According to the theory regarding social acceptance issue (Specht et al., 2016), the analytical framework could be applied to form the specific questions.

The three components of this theory are 'subject of acceptance', 'object of acceptance' and the 'specific context' (Specht et al., 2016).

The first element,'subject of acceptance' represent the identification of the potential stakeholders involved in rooftop farming development in the context of China and their previous general knowledge about UA (Sanyé-Mengual et al., 2016) and rooftop farming. Therefore, the first two specific questions could be phrased as:

1. Who are the potential relevant stakeholders involved in rooftop farming development process in context of China?

2. What are the general perceptions and conceptualization towards UA and rooftop farming?

The second element of this theory is the 'object of acceptance' which stands for the factors related to rooftop farming. For instance, the perceived benefits and risks of rooftop farming in the terms of social, environmental, economic and aesthetical aspects, and one more extra aspect of risks and problems is technology aspect. (see also in Figure.3). As a result, the next two questions could be formed as:

3. Which perceived benefits may positively affect the acceptance and success of rooftop farming in context of China?

4. Which perceived risks and problems may cause the failure or rejection of the rooftop farming in context of China?

The third component of this theory is the 'specific context' that shapes the environment in which the acceptance process occurs (Specht et al., 2016). Specht et al. (2016) practically applied this component in their study by two concepts, promoting context factors and hindering context factors, in the terms of political context, legal framework, market situation, spatial context, and innovation process (see also in Figure.3). This research will also use these five indicators. Hence, two more specific questions related to this are listed below:

5. What are the promoting context factors in the introduction of rooftop farming in context of China?

6. What are the hindering context factors in the introduction of rooftop farming in context of China?

3. Methodology

In this section, the methodologies used to investigate each SRQ will be introduced. The figure.4 shows an overview of the SRQs, relevant concepts, methodologies, and indicators. Each methodology is explained specifically subsequently.

SRQ	Concepts	Methodologies	Indicators
Who are the potential relevant stakeholders involved in the Shanghai's rooftop farming development process?	Subject of acceptance	Literature review Snowball sampling	Background Role
What are the general perceptions and conceptualization towards UA and rooftop farming?	conceptualization	Document analysis Semi-structured interview	Official definition Stakeholder's definition
Which perceived benefits may positively affect the acceptance and success of rooftop farming in Shanghai?	Object of acceptance	Semi-structured interview	Social benefits Economic benefits Environmental benefits Aesthetic benefits (Specht et al., 2016)
Which perceived risks and problems may cause the failure or rejection of the rooftop farming in Shanghai?	Object of acceptance	Semi-structured interview	Social risks Economic risks Environmental risks Aesthetic risks Technology risks (Specht et al., 2016)
What are the promoting context factors in the introduction of rooftop farming in Shanghai?	Contextual factors Promoting context factors	Semi-structured interview Document analysis	Political context Legal context Spatial context market situation Innovation process (Specht et al., 2016)
What are the hindering context factors in the introduction of rooftop farming in Shanghai?	Contextual factors Hindering context factors	Semi-structured interview Document analysis	Political context Legal context Spatial context market situation Innovation process (Specht et al., 2016)

Figure.4 Overview of SRQ, concepts, methodologies, and indicators (Self-made)

3.1 Case study approach

This thesis used case study approach to fulfill the research objective. The case study approach is usually applied when in-depth and complex investigations and researches are needed in a real-life context. (Crowe et al., 2011) It is a kind of research approach that has been applied widely in the field of social science. Especially it is eligible for addressing issues related to institution, land use, activity, cultural setting, and area. In this study, rooftop farming is a realistic project and is different in various real-life contexts, hence the case study approach could provide a real phenomenon to research the performance of the rooftop farming topic. Besides that, the research questions formulated above are all set in a particular context, so the case study approach were useful to collect the empirical data and answer the research questions. Furthermore, Stake (1995) classified case study approach as three main types in his book, intrinsic case study, instrumental case study and collective case study. According to his definition, intrinsic case study means the researchers intend to explore a unique case context which is largely different from other cases. While the instrumental case study needs researchers to choose a specific case that could bring a broader knowledge about a particular issue or context. The collective case study has same aim as the instrumental case study. In order to gain a broader and comprehensive understanding of an issue, researchers need to study different cases simultaneously or sequentially to make more comparisons. This study conformed to the characteristics of instrumental case study type because the existing studies were concentrated on the context of Europe, and the case study of China brought a broader knowledge of rooftop farming issue in the global range. Therefore, the instrumental case study was the most proper study type for fulfilling the objective and answering the research questions of this study.

3.2 Case selection

Because the objective of this research is to investigate the stakeholders' perception in China, an area of China was selected as a case. In the process of case selected, I searched ‘rooftop farming' as a keyword in Chinese google and literature searching website, I found that most of information was related to Shanghai. Which gave me an inspiration that Shanghai may be a proper case for this research. When I focused on searching relevant information of rooftop farming development in Shanghai, I found that the number of relevant literatures regarding Shanghai rooftop farming issue was very limited and the cases mentioned in this researched appeared repeatedly. Therefore, I had a preliminary judgment that the rooftop farming development in Shanghai is still at early introduction stage, in which the perceptions and acceptance of relevant stakeholders who were involved in rooftop farming process is important. The characteristics and situation of Shanghai conforms to the research objective of this paper.

Furthermore, Shanghai is the economic center of China, many innovations will firstly land on there. For example, Shanghai is the first city in China which had its own by-laws regarding green roof initiatives. The government of Shanghai even formulated the target of construction of green roof area annually. It shows the government of Shanghai has the interests and ambitions in developing green roof. According to the statistics in the end of 2014, there are 2900 hm2 vacant roof area in Shanghai and more than 70% vacant rooftop could be available for roof greening (Kun et al., 2014). Kun et al. (2014) also suggested in their article that the rooftop farm could be an innovation for the rooftop greening project. Furthermore, the V-ROOF rooftop farming project in Shanghai is always the case study of the a few existing papers regarding rooftop farming issue in China (Shengxuan Zhu & Ning Gao, 2013). It proves that the development of rooftop farming in Shanghai will possibly be studied and imitated by other regions of China and promote the development of rooftop farming in the whole China. In addition, the government of Shanghai is more transparent and efficient comparing to other cities of China, therefore the case study in Shanghai is more convenient.

Shanghai is divided as 16 districts geographically and administratively. Currently, in Shanghai, there are two types of rooftop farm development modes. One type of mode is bottom-up that was initiated by private business developer and supported and subsidized by government. The other type of mode is top-down that was initiated by government and operated by private sector. The figure.5 below is the map of Shanghai.

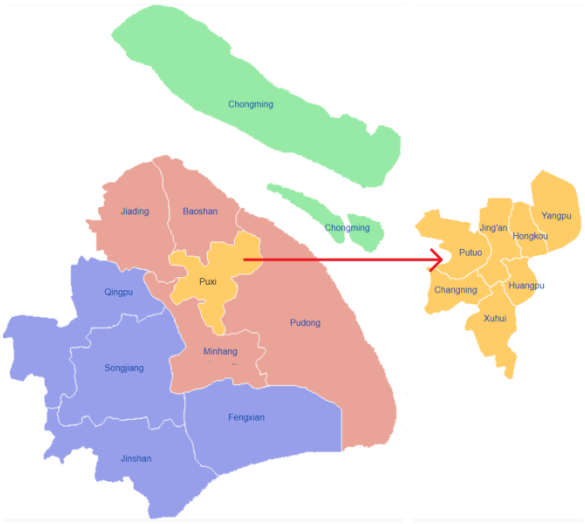


Figure.5 Shanghai administrative division map (self-made)

In addition, in terms of governance, the roof greening project is administered by Shanghai City Greening Department and the green roof commitment and technique guidelines are edited by it. Urban agriculture is administered by Shanghai Agriculture Commission. Shanghai Jiaotong

University and Tongji University are two research sectors involved in rooftop farming and urban agriculture research, both of them have cooperation with government.

3.3 Data collection

3.3.1 Interviews

As the objective and research questions of this study are aiming to collection stakeholders' perceptions, interview was selected as the main method in this research to collect data. Rabionet (2011) summarized 6 stages when he conducted interviews: identify the type of interview, formulate ethical principles, craft interview protocols, conduct, and record interview, analyze and conclude interview, and report interview. In the data collection methodologies section, the first four stages will be demonstrated respectively, and the selection of interviewees will also be explained in this chapter.

The type of interview

In this research, I chose semi-structured interview. It could provide a set of open questions and allow the interviewer to discuss with the interviewees. It helped interviewer to change the interviews content in time according to different situations and explored more useful information beyond the previous question setting. Therefore, by doing so, I was able to cover all of my interesting and pre-determined questions in the interview and at the same time, I also had the opportunity to hear their own experience and stories. A completely unstructured interview may cause the conversation deviate the correct direction and the conversation is possibly lost control in the end, consequently, the collected data may be not available for the original research purpose. In addition, the completely structured interview will constrain the flexibility of the interview, as a result, it will restrict the possibility of finding new interesting points. Therefore I applied semi-structured interview in this research.

The selection of interviewees

To investigate the first specific research question and identify the potential relevant stakeholders, the literature review and snowball sampling methods were chosen to be applied. Combining other researches stakeholders selection and practical investigation process, the stakeholders groups consisted of experts, rooftop farming initiators, clients, administration, and unions. Experts have general and academic knowledge about rooftop farming, their opinions will reflect the academic perceptions towards rooftop farming. Rooftop farming initiators have direct experience on rooftop farming, because they participate in the entire process of building, operation, and managing rooftop farms. They have clear vision on practical rooftop farming initiatives. Clients are the service object of rooftop farms. They are different with other stakeholders, and their perceptions base on a perspective of participants. Administration group

has great impacts on the development of rooftop farming because they have stronger political power, which will affect the political context of rooftop farming development. Lastly, unions represent the attitude of NGO. They are a group of people who have same hobbies or willingness, the power of unions is also strong enough to affect the development of rooftop farming.

After identifying key stakeholders from each group, more relevant stakeholders were identified by using snowball sampling approach. Snowball sampling was defined as the researchers reach some interviewees through the contact information that was offered by other interviewees. The process is repetitive, each interviewee or stakeholder has the potential to provide the information of other unknown stakeholders (Noy, 2008). In the field of social science study, snowball sampling is one of the most widely applied methods of sampling in qualitative researches. It could help researchers to enrich sampling clusters, and access new stakeholders and relevant group (Noy, 2008). Because there was no any previous study containing the stakeholder identification of rooftop farming issue in Shanghai, most of the stakeholders were hidden and unknown by researchers. In this situation, the snowball sampling approach could provide researchers an opportunity to break ice. Firstly, through the literature review method I identified the general range of the relevant stakeholders and then I applied the snowball sampling method to finalize the stakeholder network. As a result, 12 stakeholders were added into various stakeholders group.

In summary, the principles of the stakeholders identification process could be defined as two aspects. On the one hand, used the literature review and existing knowledge to generate relevant stakeholders contact information as much as possible. On the other hand, applied snowball sampling method from the most obvious or powerful stakeholders to make the stakeholders map clearer. The Figure.6 below is an overview of the interviewees.

Stakeholder Group	Amount	Stakeholder	Brief Introduction	Interview File No.
Expert	2	Urban Planning Professor	The urban planning field professor of Tongji University who also is the founder of urban food forest development organization	Expert_1
		Urban Agriculture Professor	The professor of Jiaotong University who has many researches regarding urban agriculture	Expert_2
Rooftop Farm Initiators	3	State-owned Enterprise	A state-owned food enterprise which is in the period of reforming	Initiator _1
		Environment Consultant Firm	An environmental consultant company which also has the business of developing non-profit urban gardens	Initiator_2
		Commercial firm	A rooftop farm operation company which has a large rooftop farm in the rooftop of a commercial building	Initiator _3
Client	4	Consumer	A consumer of a rooftop farm who has a high attendance frequency	Client_1
		Consumer	A consumer of a rooftop farm who has a low attendance frequency	Client_2
		School Teacher	A teacher who takes charge of the rooftop farm in the building of a primary school	Client_3

		School Student	A primary school student who was farming in the rooftop farm	Client_4
Administration	1	Government Officer	The government office of Shanghai Municipal Agricultural Commission	Administration_1
Unions	2	Urban Farmer	An Italian migrant who loves to farm	Unions_1
		Urban Farmer	A New Zealand migrant who loves to farm	Unions_2

Figure.6 Overview of interviewees (self-made)

In total, 12 interviews were conducted in the field work. In the group of experts, two experts from Jiaotong University and Tongji University were interviewed, and they are urban agriculture expert and urban planning expert respectively. Three rooftop farming initiators were interviewed by me. They are the representative of three different types of private company: State-owned enterprise, Environment consultancy company, and rooftop farming start-up company. The client of rooftop farming included two consumers of a rooftop farming project who were differentiated by the attendance frequency, one teacher who take charge in a rooftop farming project on a primary school building top, and a primary student who was working on the rooftop farm when I visited. In terms of government, the contact persons of Shanghai Municipal Agriculture Commission was interviewed by telephone. In addition, two migrants were interviewed together as the role of urban farmers. They belong to a non-official urban farmer union which was composed by a group of people who love to do urban farming activities. They usually communicate and share experience via an online chat group, but the interesting point is the number of migrants or foreigners is more than the number of Chinese. The two urban farmer interviewees are two of most active urban farmers and they are playing various roles in the urban farming process, for instance, they are initiators of particular tiny rooftop farm as well as clients. Therefore, the interview with them was helpful for the research to know the perceptions of non-official unions, meanwhile, understand the ideological difference between migrants and local people.

The ethical principles

Because the research object is human, some guidelines or rules were identified before conducting the interviews. In terms of respecting each interviewee, firstly each interviewee was informed in advance and they have right to agree or reject the interview. Secondly, the purpose and the basic procedures of the study were shared with interviewees. Thirdly, the identity of the interviewer was anonymous and lastly the use of the data was shared. Moreover, considering the justice of research, participants were not selected solely due to their limited ability to refuse. In China, the administrative officers were more sensitive about interviews, the information about the interview was shared before the interview, and their privacy was protected.

The interview protocol

This stage included two components, preparing the introduction of me and the research, and formulating the questions being asked in the interview. The introduction contained my basic information and the objective, plan, problem statement of the research. And the opening statement was phrased to be able to attract interviewees to truly concentrate on and participate in research process and made sure they had comfortable phenomenon to take the interview. Besides the opening introduction, the interviews consisted of other 7 parts: 1. Their basic information and their relationship with rooftop farming. 2. Their general perceptions and conceptualizations on UA and rooftop farming. 3. The benefits of rooftop farming. 4. The risks of rooftop farming. 5. The promoting context factors 6. The hindering context factors 7.the weight that they assigned to each factor (from the scale 1-5) 7. Other potential relevant stakeholders involved in rooftop farming. The complete interview content list is attached in Annex.1.

Conduct and record the interview

First of all, the methods of recording are approved by interviewees. The audio recording is the best way to clearly record the interview content and enable interviewer concentrate on the interview content. However, when the interviewee rejects the audio recording, I use hand-writing note as the recoding method. The quality and battery capacity of the recording equipment are considered to avoid potential failure.

3.3.2 Document analysis

The other data, for instance, the legal framework, political context of rooftop farming issue was generated from governmental documents. The documents of ‘The Thirteenth Five-Year Plan of Shanghai Modern Agriculture Development’, ‘Shanghai Urban Constructions Planning Management By-law’ and ‘Shanghai Food Sale Qualification Application Procedure’ were analyzed. Because the policies about rooftop farming are limited, only a few terms were related to rooftop farming project, the documents were verbatim analyzed. The results will also be

presented in Results chapter. The term of urban agriculture in master plan is presented in the attitude of urban agriculture section; the terms of construction law and food selling qualification is presented in hindering contextual factors section.

3.4 Data analysis

The narrative textual data was numerous and unanalyzable before managing and classifying the content. Ranjit (2014) summarized content analysis for qualitative research into four main steps.

Step 1. Identified the main themes. Above all, I carefully looked through the narrative answers provided by each interview and tried to understand the exact meaning that they expressed. And then I built various themes that could cover and represent all these meaning. In the process, it was noted that sometimes stakeholders described same meaning by using different words. Furthermore, the wording of the theme was ensured to be as accurate as possible, especially in the translation process.

Step 2. Coded the main themes. The aim to code the themes was to count the number of times a theme had occurred in all the interviews.

Step 3. Classify interviewee answers under various themes. After identifying the main themes and coding them, the next step was to classify all of the transcripts and notes under the different themes.

Step 4. Integrated themes and responses into the report writing. After all of the content analysis, the next issue was to transfer this data into the text of the final report. In this thesis, the various themes associated with the classified responses were written and summarized as different perceived factors that will affect the social acceptance of rooftop farming development in Shanghai.

All of the data analysis phase was processed considering the research questions and research objectives. In the end, the analyzed data is able to answer the pre-setting research questions and comparable to other literature.

Furthermore, in the interviews, I asked interviewees to weight and express their perceptions regarding the importance of each factor. In the data analysis process, I counted their answers and tried to use the importance scale to represent the general importance of each factor. The importance of each factor was calculated by two criteria. One is the frequency of occurrence of a certain theme (factor), this criterion was derived from the step 2 of content analysis; the other one is the average weight (Scale 1-5) that the stakeholders assigned to the factors in the interviews. (Specht et al., 2016) In the end, in order to consider the impact of two criteria simultaneously, the two parameters were multiplied, the final score was presented by the general importance scale (Scale from A to AAA). AAA stands for very important; AA

represents important and A means less important. The calculation rule is shown in Figure.7. The upper level of each final score range is defined by the result of maximum score (12X5) divided by three. There every 20 scores is a block.

Final score range	General importance scale
1-20	A
21-40	AA
41-60	AAA

Figure.7 The general factor importance scale calculation rule

For example, one benefit factor was mentioned 6 times by different stakeholders, and the average importance scale they weighted in the interview was 4, then the product of these parameters is 24. As a result, the general importance scale of this factor is AA, important.

3.5 The quality of research

Donnelly and Trochim (2007) introduced four criteria that influence the quality of qualitative research: credibility, transferability, dependability, and confirmability.

3.5.1 Credibility

Donnelly and Trochim (2007, p.149) defined credibility as ‘credibility involves establishing that the results of qualitative research are credible or believable from the perspective of participant in the research'. As this study aiming to investigate stakeholders' perceptions regarding rooftop farming issue, the selection of participants and their answer's accuracy will influence the credibility of the research. Therefore, the selection of interviewees needs to be scientific and accurate. The interviewees should have high impact and power on rooftop farming issue and should cover different stakeholder groups. The selection of stakeholders in this research was combined by our researchers' opinions and China practical context, and all the stakeholders are involved in the early stage of rooftop farming development in Shanghai, their impacts is high because the reasons of the stakeholder group setting which is explained in interviewees selection section.

3.5.2 Transferability

This refers to the degree to which the results of qualitative research can be generalized or transferred to other contexts or setting' (Donnelly and Trochim, 2007, p.149). As Shanghai is one of the representative cities in China for economy and innovation, the experience and findings of Shanghai should have the transferability to the other contexts of China. The transferability from China context to international context will be illustrated in the Discussion chapter.

3.5.3 Dependability

According to Donnelly and Trochim (2007, p.149), dependability is ‘concerned with whether we would obtain the same results if we could observe the same thing twice'. This requires the study should have extensive and detailed record of the whole process of the research, including the participants name, contact, interview questions, answers and the analyzed documents. Therefore, the recording is necessary and important procedure in the whole research process. The dependability was also considered in the process of interview transcripts translation. Because the original interview transcripts were in Chinese, in order to properly use these data for English writing, the dependability of translation is very important. In the process, I tried to keep the correction of translation and double checked the Chinese version and English version. In my opinion, I think the influence of translation for research result is limited.

3.5.4 Confirmability

This refers to ‘the degree to which the results could be confirmed or corroborated by others’ (Donnelly and Trochim, 2007, p.149). In order to ensure the confirmability of the research, the collected data was shared with interviewees, and I requested them to double-check transcribed data.

4. Results

4.1 Subject of acceptance

My analysis of the rooftop farming development in Shanghai is based on the 12 interviews of relevant stakeholders. Their perceptions and opinions are the objective facts of the academic research. During the fieldwork period, I have investigated 12 stakeholders who were distinguished by 5 stakeholder groups. These interviewees have different roles and relations with rooftop farming in Shanghai, therefore their backgrounds and knowledge toward rooftop farming issue are various enough to get the research results from multiple perspectives.

They also started to get involved in rooftop farming in recent 5 years. However, they begin getting involved in rooftop farming due to different reasons. Hence, they have various general understandings towards rooftop farming.

4.1.1 The attitude towards urban agriculture

This section refers to the interview question 3:

How do you define urban agriculture from your perspective?

-What do you think the functions and significance of urban agriculture?

-What do you think the current situation of urban agriculture development in Shanghai?

In the previous chapter, I mentioned some researchers concluded the driver of urban agriculture will influence the development of rooftop farming; hence I formulated question 3 to explore the stakeholders' attitude towards urban agriculture and try to analyze its relation to rooftop farming. Through the analysis, I find their attitudes can be generally divided into two groups. A group of the stakeholders (Expert_2, Initiator_1, and Administration_1) have a broader definition of urban agriculture. They broadly interpret all of the agriculture activities in Shanghai belong to the range of urban agriculture. Moreover, the municipality is aiming to promote urban agriculture's modernization in next 5 years' master plan (derived from official document: The Thirteenth Five-Year Plan of Shanghai Modern Agriculture Development). The government officer describes the current development of urban agriculture in Shanghai:

‘In 1994, Shanghai is the first city in China that came up with the vision of developing world-class modern urban agriculture, in order to follow other international megacities' step.' (Administration_1)

‘Nowadays, urban agriculture is growing prosperously in Shanghai, but we never stop the step to further modernize it’ (Administration_1)

Because the state-owned company and the urban agriculture professor have more communication and interaction with the government, they are highly consistent in terms of ideology. Therefore, this side of stakeholders all thinks the driver of the urban agriculture is improving food production and satisfying people's basic food demand.

However, the rest stakeholders narrowly defines the urban agriculture should be the agriculture activities occurring in the traditional urban area rather than peri-urban or rural area. According to their definition, they deem the current development of urban agriculture in Shanghai is still in a very initial phase. Some of them even think the government did really limited efforts on developing urban agriculture. The representative of the environmental consultant company gives his explanation:

'I believe the reason why urban agriculture is poorly developed in Shanghai or China is because the food scarcity problem has not been an incisive social contradiction. Only when it becomes a social contradiction, it will gain more attention and more investments from the society.' (Initiator_2)

This side of stakeholders explains their view as urban agriculture is more like a social and education tool. They believe urban agriculture can barely contribute to food production. They think the driver of urban agriculture is its social functions.

However, there are two points that all of these interviewees reach an agreement. Firstly, they all define rooftop farming as one type of urban agriculture. Secondly, they all admit rooftop farming development in Shanghai is still in an early stage.

In my interviewee samples, only 25% interviewees (Expert_2, Initiator_1, and Administration_1) believe the driver of agriculture should be improving food production, whereas 75% interviewees (the rest stakeholders) deem the driver is its social function, such as education or promoting community harmony. I assume this condition, If the two different perceptions proportion of the 12 interviews is similar with proportion of the whole Shanghai's population, more people may think urban agriculture's social function is its original driver instead of its food production attribute. As a result, the rooftop farming's food production value is neglected by most of stakeholders, as a result, the large-scale development of rooftop farming is considered as an unnecessary initiative.

4.1.2 The general perceptions towards rooftop farming

This section refers to interview question 4:

How do you define rooftop farming from your perspective?

-What do think the functions and significance of rooftop farming?

-What do you think the current situation of rooftop farming in Shanghai?

-What do you think the relationship between urban agriculture and rooftop farming?

In this part, aiming to answer the interview question that how stakeholders define rooftop farming. Through analyzing the interviews, I find that the stakeholders general perceptions towards rooftop farming can be mainly divided into two sides. One side of people think rooftop farming is essentially agriculture activity, hence, its food production function should be noted. The other side of stakeholders believe the social characteristics of rooftop farming is more obvious. More details about their general perceptions will be presented subsequently.

The two experts are involved in rooftop farming issue because of their special academic research fields. Firstly, the urban planning professor believes the eatable landscape is a trend of the future, which is able to bring more significance to the modern urban life. Meanwhile, he is also the founder of a non-government organization dedicated to develop urban food forest projects. Because of these two social roles, the professor starts to touch the rooftop farm. However, in his mind, he never emphasizes the concept of rooftop farming on purpose. He explains his opinion:

'Actually, I never name it as rooftop farming or rooftop agriculture, because I think both of the rooftop farm and other urban garden landscape, essentially are special forms of urban greening.' (Expert_1)

'We should focus more on the green landscape that can bring more interactions with human, thus I didn't particularly define it as rooftop farm or urban farm. I think we don't need to emphasize the agricultural attribute of the rooftop landscape, as long as it can provide people joy and some positive consequences that may be physical or spiritual.' (Expert_1)

From his perspective, he illustrates rooftop farming is just one of the greening forms. Its interactive meaning is larger than agricultural meaning.

However, the urban agriculture professor has a different viewpoint. He is not involved in any actual rooftop farm project, but he did many relevant researches. He strongly believes that the rooftop farming is valuable and necessary to gain more attention from the society as it will be one of the best solutions to solve the possible food scarcity problem in the future. He also describes that the rooftop farming can be a good supplement of urban agriculture, although the rooftop farming is facing to a number of risks and obstacles, it still has large potential to contribute to the food production in the future.

Similar as these two experts' opinions, in general, the other stakeholders also have these two kinds of views towards rooftop farming. A large part of stakeholders doesn't care too much about the agricultural attribute of rooftop farming. For instance, the environmental consultant

firm operates the rooftop farm as a social welfare project. They built a few rooftop farms in the buildings of the primary schools; nonetheless, they don't need to invest any money. In practice, they are funded by other large-scale companies who have the need to do team building. These companies invest money and the primary schools provide the roof as free, in return, the companies will get an excellent project to organize team building activities and the schools will have a best place for natural education. The general perceptions towards rooftop farming are closely related to the purpose of the stakeholders. Commercial enterprise regards rooftop farm as a tool to make profit; the urban farmers think rooftop farming is an activity that can satisfy their hobby of farming; consumers think rooftop farm is a place where they can relax themselves. As a result of their various purposes, they firstly conceptualize rooftop farming as other tools instead of an agricultural product.

Whereas, there are still a few interviewees naturally link rooftop farming to agriculture or food production. The state-owned company elaborates the rooftop farming is a good example of CSA (Community Support Agriculture). They said:

'We have some theoretical data showing that 10 square meters' vegetable planting can fulfill the daily vegetable need of a family of three, especially in the mega city like Shanghai, most of families only have dinner in their home.' (Initiator_1)

Through the interview with this company, I find the history and background of this company result in they care more about the food production significance of the rooftop farming. They were a food production state-owned company and reformed into an asset management company three years ago. After the reformation, they start to offer some vacant offices for the start-up companies as free and try to combine their new ideas to do make innovations in the field of food production. At this moment, a start-up team proposed a scenario of building a rooftop farm which fits their original thought perfectly. From this story, I find that because they know more about food production or agriculture and have plenty of relevant experience, they are able to see the food production potential of the rooftop farming. As such, the Agriculture Commission officer also shares the same view.

Generally speaking, the stakeholders who have the thought that rooftop farming should be introduced as a new form of urban agriculture all have the experience related to food production or agriculture. They have more knowledge about food production and agriculture, thus they are able to see the potential of improving food production of rooftop farming. The other stakeholders' general perceptions towards rooftop farming will differentiate from their own specific objectives.

4.2 Perceived benefit, risks and problems

According to the conceptual framework I explained above，‘object of acceptance' means perceived benefits and risks. In this element, I will illustrate the potential benefits, risks, and problems of rooftop farming by analyzing and extracting from interviewees' answers. Each benefits or risks will be weighted by the importance scale. AAA stands for very important; AA represents important and A means less important. The calculation guideline is explained in the methodology chapter.

4.2.1 Perceived Benefits

This part of result is related to the interview question 5 in Annex.1. In general, in terms of each category, according to interviewees’ descriptions, almost every stakeholder has mentioned social benefit is the most prominent benefit of rooftop farming. Moreover, governmental stakeholders and expert group more care about its environmental values than economic values, nonetheless the initiator group holds contrary views, economic benefit is their concern. They all agree that aesthetic benefit is least important aspect. An overview of perceived benefits and related importance scale is illustrated in Figure.8. The specific perceived factors distribution and the calculation of importance scale will be presented in Annex.2.

Aspect	**Perceived benefits**	**Importance**
Social	Farming and natural education	AAA
	Improve citizens’ awareness	AA
	Promote community harmony	AA
	Offer places for social activities or company team building	A
	Improve the interaction between landscape and citizens	A
	Shorten the distance between the enterprise and citizens	A
Environmental	Increase urban greening area	AAA
	Lower urban heat island effect	AA
	Improve air quality	AA
	Reduce carbon emissions	A

	Increase creature habitat area	A
	Filtrate rainwater	A
	Improve organic recycling	A
Economic	New business model and opportunities	AA
	Zero investment for school	A
	Increase consumers flow of the commercial building	A
Aesthetic	Improve rooftop aesthetics	A
	Improve urban skyline aesthetics	A

Figure.8. perceived benefits and related importance scale

First of all, in terms of social aspect, the majority of stakeholders describe rooftop farming as an education tool. No matter the rooftop farm projects that are on the primary school's building, commercial buildings or public buildings, they all attract consumers by propagandizing its educational value. The owner of the commercial rooftop farm project said to me:

'We want to build and develop our rooftop farm as an educational base, in order to realize this target, we have hired 10 teachers to guide our consumers basic farming skills and our memberships are free to consult planting knowledge all the time.' (Initiator_3)

The environment consultant company also extremely advertises the educational benefits of their projects on the rooftop of primary schools:

'At the beginning, we were looking a proper place to settle down our rooftop farm, at this moment, a primary school contacted us they were willing to offer a large vacant rooftop area for free, as long as we can return them an excellent place for natural education.' (Initiator_2)

'The fact proves that this mode is the best mode we have found, and the rooftop farm is running perfectly. The natural education lectures even can deal with the farm's daily maintenance issue, which saves many costs on labor' (Initiator_2)

From the perspectives of client, they are also very satisfied with its educational significance. A consumer always brings his kid to the commercial rooftop farm and he said he can realize the change of his kid:

‘I bring my kid to the farm almost twice a month. At the beginning, he always complained the soil was too dirty, but gradually he fell in love with taking care of those lovely plants. His dining habit was changed as well, he prefers to eat vegetables and seldom waste them.’ (Client_1) The other consumer also states that the education value for his child is the only reason he is willing to buy the membership. The interview with the primary school student confirmed the education benefit more directly. He said:

‘Natural education class is my favorite course, as I’m very happy to witness my little plant grow up and I finally know how hard to grow up to a ripe vegetable from a seed’ (Client_4)

Another important benefit is improving citizen’s awareness. Most of stakeholders mentioned through rooftop farm urban the citizens can learn more about farming skills. They start to realize the importance of cherishing each kind of food resource. Furthermore, they are aware of the importance of green plants and protecting the environment. For this point, the New Zealand migrant who has lived in Shanghai for 13 years has deeper understanding as an urban farmer:

‘I do get people drop into volunteer from time to time, and they don't realize how hard the gardening work actually is. And they were really shocked; often these people don't come back again because it was a hard work. They buy their vegetables in the supermarket, and they were all beautifully watched and packaged. They don't realize where these things come from. So I think it's important for people to connect to the environment, they may appreciate where the food comes from and they may also start to think about the waste that goes with packing in the supermarket. I think these things are important since it's an education tool and social tool.’ (Unions_2)

A part of stakeholders (see Annex.2) thinks the rooftop farming can promote the communal harmony because those rooftop farms located in the community can attract local residents come to work together and communicate mutually. Especially in this society where people seldom get touch with their neighbors, this benefit is seemed to be more valuable. Moreover, the rooftop farm is a great place to organize some activities, for example, community activity or company team building. It expands the traditional activity forms, being more green and sustainable. Urban planning professor also supplements a social benefit that this landscape can bring more interaction with citizens which is the highest goal of a landscaper. The state-owned company explicates that the rooftop farm can shorten the distance between them and local residents, as their company and farm is located nearby a large community.

From the aspect of environmental benefits, most of interviewees will firstly come up with three points: increase city greening area, lower urban heat island effect and improve air quality. These three benefits sharply are the very serious environmental problems in Shanghai (Cui and Shi, 2012). It is also the original intention of Shanghai greening department to encourage rooftop

greening development. However, almost every stakeholder admits that the environmental benefits will only be obvious when the rooftop farming is developed in a huge scale. Currently the environmental benefits are very limited.

'We have made an analysis, if all of the feasible rooftops in Shanghai are retrofitted into green roof, the per capita green area will increase more than 30%' (Initiator_2)

Although only a few interviewees realize reducing carbon emission is also a tremendous potential benefit, the calculation result of the importance scale of this point is A (see Annex.2). Carbon emission of traditional agriculture and food supply is always a neglected issue by most people. Many costs are from the transport process; however, rooftop farm can extremely shorten the supply chain and reduce transport. The state-owned company explains their idea:

'We expect an ideal situation of rooftop farm that surrounding residents come to pick the vegetables up before they go back home, so they don't even need to go the market any more. This vertical logistic system can save a lot of long distance transport' (Initiator_1)

Moreover, some people also mention that improving creature habitat area, filtrating rainwater and improving organic waste recycling are also able to be regarded as the environmental benefits, but these factors are less important.

In terms of economic benefits, most interviewees state the rooftop farming has the potential to be a new business model to create benefits, but they all agree there has not been a mature business model in the market. The rooftop business man describes his rooftop farm business like this:

'Our farm hasn't realized financial sustainability, and we are still exploring a better business model to attract more consumers and make more profit.' (Initiator_3)

'We have agreed it is impossible to make profit by selling the food products, so we have to earn money by its additional values, for example, education and entertainment values.' (Initiator_3)

Some other stakeholders have different opinions, for instance, the urban planning expert points at the rooftop farm should not be a profitable project. Moreover, for the rooftop farm cases built in the school building top, the initiator and the teacher of the school both think it is a perfect economic benefit that they don't need to invest any money but can gain a great education spot. The private business company also reveals his special corporation relation with the commercial building:

'Because my farm is on the rooftop of a shopping mall, a large part of my consumers will probably consume at the shopping mall as well. It is helpful to increase the consumer flow of this commercial building. In return, they rent the rooftop area to me in a very low price.'

(Initiator_3)

Considering these two benefits are constrained by particular projects, only a small number of stakeholders can realize these two points, so the importance of them are A.

The majority of interviewees don't think aesthetic benefit is a very important aspect except the urban planning expert. He deems the rooftop farm should be a beautiful landscape that can improve urban skyline aesthetics and beautify city image. Other stakeholders explain that they don't have professional landscape design skills, thus they can only make a really basic planning. The Italian urban farmer said:

'Although we are not mastered at landscape designing, our rooftop farm is still more beautiful than the previous appearance of rooftop' (Unions_1)

The primary school student said: 'I think most beautiful thing is that I can see various kinds of colors in the rooftop' (Client_4)

In summary, concerning the amount of perceived benefits, social and environmental benefits are two primary benefits aspects. There are one very important benefits factor in social aspect and one very important factors in environment aspect, however, only one economic benefit is analyzed as important and two aesthetic benefits are both less important.

4.2.2 Perceived risks and problems

An innovative program not only has benefits, but also is associated potential risks and problem. These potential negative factors may affect and restrict the development of rooftop farming. Some risks or problems have existed in the process of building a rooftop project and been solved in the end, whereas a part of risks still probably happen in the future. This section is the explanation for the other part of interview question 5 (see Annex.1). Generally speaking, relevant stakeholders' worries about potential risks are lower than their expectation to it potential benefits, which can be illustrated by the importance scale of each factors (shown in Figure.9). The specific perceived risks factors distribution and the calculation of importance scale will be presented in Annex.3.

Aspect	Risks and problems	Importance
Technology	Technology threshold is too low	A
Social	Project are abandoned and resources are wasted	A
	Resource may be occupied by private client	A
	Relevant stakeholders' objection	A
	Food safety risk	A
Environmental	The damage to the rooftop	A
	Soil dust	A
	Fallen leaves are too many	A
	Adour of fertilizer	A
Economic	Limited or no economic profits	AA
	Maintenance cost is high	AA
	Education cost is high	AA
Aesthetic	The project is not beautiful enough	A

Figure.9. perceived risks and problems and related importance scale

First of all, concerning technology aspect, Initiator_1 and Initiator_3 express their worries that if the technology threshold is too low, the general level of this whole industry will be very low as well. The state-owned company staff explains her philosophy:

'If we don't have a high technology standard to restrict farming on the rooftop, the threshold of this field will be too low. In this condition, many unqualified practitioners will join in to this field casually, bringing a lot of unpredictable risks.' (Initiator_1)

In terms of social aspect, a part of stakeholders (see Annex.3) concerns quite a number of projects will be abandoned and resources are wasted in the end. From the conversations, I know some investors are not discreet enough when they start to develop rooftop farm projects. In other words, they didn't prepare well before they step into this field. As a result, many projects

are ended with failure and the building top fell into decay. For those rooftop farm projects built on the top of public buildings, the ownership of the particular partial farm area may be a trouble. 'I'm worrying about the public rooftop farm will be occupied as private farm area by residents in the community. If this situation happens, it may cause unnecessary dispute' (Initiator_2), later on he explains this risk can be tackled in this way: 'I think the proper solution is the third-party take charge of organizing the public rooftop farm and formulate comprehensive and clear rules to manage it.' (Initiator_2) Two experts come up with their concerns that the rooftop farm project may be objected by the neighbors since they barely know the rooftop farm and will naturally reject any new things. Nonetheless, they believe this contradiction can be dealt with by communication. Moreover, one stakeholder has her personal worry: 'I have imagined a situation that rooftop farming develops extremely well and people have highly accessibility to any urban farms. The biggest risk of this situation is food safety. I'm worrying some criminals may poison the food products in the farm in order to take revenge on society. It is really difficult to monitor this worst behavior, because it is almost impossible to recognize the criminal is irrigating the crops or poisoning it. I hope it won't happen, but once it occurs, many our efforts will be ruined.' (Initiator_1)

Environmentally speaking, all of opinions of potential environmental risks and problems are from Client stakeholder group. They list four main risks: 1.the root of the vegetation may damage the roof of the building. 2. The dust of the soil may pollute air. 3. The fallen leaves may have negative impact on urban environment. 4. The stink of organic fertilizer will worsen surrounding atmosphere. However, the other interviewees reach an agreement that current environment risks are completely able to be tackled by technology methods. For example, the root barrier membrane can keep roots from penetrating the roof layer and causing leaks. Moreover, the membrane coverage on the soil surface can prevent soil dust from being blown to air. Therefore, all environmental risks are less important for rooftop farming development.

Economic risks are the primary concerns of many initiators. All of the initiators admit financial sustainability is the basis for them to insist on managing rooftop farming projects. However, their economic profits are still very limited and unstable. The private business man complains: 'My rooftop farm is constrained by the seasonal issue. In the winter, the consumer flow will largely decrease, associating with the reduction of profits.' (Initiator_3) The expert's statement is more direct: 'There is no any successful commercial case in Shanghai.' (Expert_1) Furthermore, the agriculture plants are more difficult to maintain than other ordinary green vegetation. It needs more labors and costs. The other problem is most Chinese people have very limited farming knowledge and skills, hence the education cost is costlier.

The aesthetic problem is less important. Both of the two urban farmers have the experience that their rooftop farm lands were complained by the property owners that the farms are not beautiful

enough. Some other stakeholders also describe landscape designing is their disadvantage, but they don't think it will have a large impact on rooftop farming development.

Comparing to perceived benefits, there is no any risk factor is considered as very important. All of perceived risks factors are less important or important. In addition, there are 18 benefits in total, while only 13 risks are perceived. Therefore, I deduce that the benefits of rooftop farming are more than its risks.

4.3 Contextual factors for rooftop farming

The context of the society is directly related to success or failure of an innovation. In this element, I will present the two-sides contextual factors that may promote and hinder the development process of rooftop farming in Shanghai, which related interview question 6 in Annex.1.

4.3.1 Promoting contextual factors

For the promoting contextual factor, interviewees come up with several factors that may have a positive impact on rooftop farming development in the current situation. Stakeholders give their opinions from the aspects of political context, market situation, legal framework, spatial context and innovation process. The overview of this element is shown in Figure.10. The specific promoting contextual factors distribution and the calculation of importance scale is shown in Annex.4.

Aspect	**Promoting contextual factors**	**importance**
Political context	Government cares about ecological civilization development	AA
Market situation	The education demand in the market	AAA
	Consumers accept rooftop farming products	AA
Legal framework	Legal framework is unclear	A
Spatial context	Large amount of available building rooftops	AA
Innovation process	Government supports start-up enterprise	AA

Figure.10. Perceived promoting contextual factors and related importance scale

Concerning political context, although many stakeholders complain government did too little to promote rooftop farming development, but government defends like this: 'In recent years,

we have shown our positive attitude to support ecological civilization society development. Rooftop farming can be seen as a good initiative to promote this target to realize.' (Administrative_1) Moreover, the urban planning expert also agrees the rooftop farming development can be combined with the ecological civilization development trend. He exemplifies by his project in the community: 'one of my rooftop farms was built on the rooftop of a community government office building. I gain this opportunity as the community government has the demand to build an eco-community and they believe the rooftop farm meets their demand perfectly' (Expert_1)

In market situation context, stakeholders find that the strong demand of education is the motivation to many initiators to develop rooftop farming. The private business man describes as:

'In China, the parents are strongly willing to invest education for their children. You can see, the majority of my clients are parents with their kids. Their education demand is not only the motivation for them to insist on coming here, but also the opportunity for me to make profits' (Initiaor_3)

Moreover, consumers generally accept the food products harvested in the rooftop farm. This point can be proved by clients' statement directly. Student said:

'I always carry some harvest to my home, because my teacher told me the food grew up here is very healthy and organic. Not only I like to take the food to home, many other my classmates also like to do so.' (Client_4)

Other clients also state that they don't worry about the quality and health of the food products; they even think the food here is safer than the market food since they know the growing process is relieved.

In terms of legal framework, stakeholders admit current legal framework is unclear for many issues of rooftop farming, and there is not a particular legal or bylaw regarding this specific topic. However, they deem the unclear legal framework may promote the rooftop farming development to some extent. They explain their views as if the legal framework is too clear, a number of things may be banned wrongly. In this unclear phase, they have the chance to try something new that legal has not defined and then they will have enough reasons and evidences to negotiate with government.

For spatial context, the answer is consistent, stakeholders think a large amount of vacant and available rooftop resources have not been used and developed. They expect more people to join in them. Meanwhile they also emphasize it is important to consider the spatial conditions when initiators choose a proper rooftop, for example, the accessibility of the rooftop, the bearing

capacity and waterproofness of the roof.

Regarding innovation process, government and experts present the whole China is strongly supporting the development of start-up enterprise. In this situation, innovations will be largely respected and got enough attention, which will promote the rooftop farming development as an innovative field.

From the results, it is seen that the amount perceived promoting contextual factors is apparently less than perceived benefits or risks, which proves there are limited contextual factors can promote the development of rooftop farming in Shanghai. Nonetheless, these promoting contextual factors are all in important scale or very important scale except the legal framework factor, which shows stakeholders' recognition for these factors.

4.3.2 Hindering contextual factors

Through the interviews with relevant stakeholders, I find there are several contextual factors have the potential to cause the rooftop farming projects fail or reject by the society. Check the overview from Figure.11. The specific hindering contextual factors distribution and the calculation of importance scale is shown in Annex.5.

Aspects	**Hindering contextual factors**	**Importance**
Political context	Few political support	AA
Legal framework	The administrative responsibility is not clear	AA
	Building top construction law is too strict	AA
	The sales qualification is too complex to apply	A
Market situation	Consumers can not insist on farming activities	A
Spatial context	Climate condition is not very suitable for rooftop farming	AA
Innovation process	Not too many resources are engaged in innovation process	AA

Figure.11. Perceived hindering contextual factors and related importance scale

In terms of political context, the complaints towards limited government support exist frequently in the interviews. Stakeholders present they barely know any special policy to encourage the rooftop farm, especially there is no any financial support from the side of government. One of the urban farmers shows me an example:

‘As what I know, Chinese government has a lot of special preferential policies for museum development. They not only fund the museum developers, also reduce a part of their tax cost. However, I didn’t see any similar policies for rooftop farming’ (Unions_1)

Stakeholders believe, if the government formulates particular policies to support rooftop farming, the development will dramatically speed up. So far, they cannot foresee any sign of policy-making.

Regarding legal framework, stakeholders have more views to express. Although they admit the unclear legal framework indirectly create some opportunities for them, they are indeed confused by a portion of legal issues. First all of, several stakeholders think the administrative responsibilities are unclear. Because rooftop farming is a transdisciplinary project, it is related to many government departments’ responsibilities. In this condition, each department may pass the responsibilities mutually, which quite confuses initiators, as a consequence, they don’t know exactly where to apply and get approval. Secondly, stakeholders present the building top construction law is too strict, some infrastructure is necessary to be built associated with the rooftop farm. I also look up the building top construction law, it says any building rooftop constructions which are higher than 0.5m can be built only when they are approved by City Planning Department, otherwise it will be regarded as an illegal behavior. (From document: Shanghai Urban Constructions Planning Management By-law) The teacher also tells his story:

‘At the beginning, we planned to build some associated infrastructures in the rooftop farm for student to relax and take a rest, and we also expected to build a covered wooden corridor for visitors to enjoy the beautiful scenery of the farm. However, the building administration department rejected our applications’ (Client_3)

Lastly, the food sale qualification is too complex to apply is another difficulty. Stakeholders explain it that it is illegal to sell the food product without any qualification and approval of relevant government department, even if they all know the food product is safe and healthy enough. Nevertheless, the process of applying the sale qualification is very complex; as a result, they have to give up applying it sometimes. They emphasize that they don’t expect to make profits by selling food products, but they do think it is a great advertising instrument to let more people know this new mode. Through document analysis, I find that there are at least 8 steps are needed to apply the food sale qualification. (From document: Shanghai Food Sale Qualification Application Procedure)

For the market situation, I hear plenty of stories from the initiators and urban farmers that their consumers or volunteers are rarely able to insist on doing urban farming longer than half a year. They think the consumers may give up farming as all kinds of excuses. For instance, consumers will quite farming due to the terrible weather, hard work of farming or limited time. Many

consumers' interest on urban farming will decrease as time goes by. They are gradually getting bored with urban farming and reconsider the meaning of it. A frequent consumer explains why he always comes to look after his plants:

'I have to admit I was attracted by the commercial advertisement at the beginning, but when I start to know how to farm and how this vegetation grows up, I find it is so amazing and wonderful. I feel like I have totally fallen in love with farming, because I can acquire joy and delight from it.' (Client_1)

However, the other consumer who seldom comes to the farm expresses his reason that he is too busy to visit the farm frequently. When I ask if he feels relaxed when he is farming, he answers me it depends on the weather at that moment.

Concerning spatial climate, almost every stakeholder agrees the climate conditions in Shanghai is not very suitable for outdoor farming, especially on the rooftop. Usually the climate conditions on the rooftop are more terrible. It's hotter in the summer and colder in the winter, moreover Shanghai is a city that may suffer from typhoon disaster. This is a large reason that some people don't recommend to build farm on the building top.

For innovation process, stakeholders describe current situation that only limited resources are gathered to innovate technologies or business model. There are only a few academic researches regarding rooftop farming topic and financial investment is lacked.

In general, the hindering contextual factors of legal framework aspect are more than other aspects. Furthermore, limited support from government and unsustainability of consumers are the hindering contextual factors complained many times by interviewees. The bad climate condition of Shanghai is a hindering contextual factor that is hard to change.

5. Discussion

In previous chapter, I have presented and described the results that I conclude from the 12 stakeholder interviews. The research is framed and conducted in the context of China, therefore the results drawn and extracted from interviews may differ from researches concerning rooftop farming in other contexts. In this section, I will compare my main research results with other researchers' finding and reveal the particularities of the rooftop farming development in China context. Moreover, I will also indicate the limitations in the entire research process, associated with my reflections.

5.1 Comparison with international context

Stakeholder groups composition

In this research, I contact and interview 12 relevant stakeholders and sperate these 12 stakeholders into 5 groups, intending to gain comprehensive data from the perspectives of initiators, participants, academic researchers and governors. Actually, a part of individual stakeholders may play multiple roles in the rooftop farming development process. For instance, the urban farmers are participants as well as initiators; the professors not only can be an academic researcher, but also can play the role of an initiator or a participant. These 12 stakeholders may have no direct connections or interaction mutually, but they represent different perspectives of rooftop farming and they have tried to understand other stakeholders' perspectives more or less. In general, I'm aiming to make use of the 12 relevant stakeholders I interviewed to identify a tiny but representative rooftop farming stakeholder network and ensure the research results are comprehensive enough.

In Specht et al. (2016)'s paper, they conduct 38 interviews and divide them into 6 stakeholders groups: activists/ projects, associations/ unions, planning/ constructions, public administration/ policy, research, and sales/ distribution. While, Sanyé-Mengual et al. (2016) structure their stakeholders groups as administration, architects, planning lawyer, food distributors and others, 5 groups in total. Comparing to these two other academic researches, the stakeholder selections are partly different. The main difference is I didn't particularly set planning/ constructions/ architects group, planning lawyer and sales/distribution group. First of all, for planning group, I have included an urban planning professor in expert group, and his views are able to stand for Shanghai's urban planner's perspective. Furthermore, according to my investigation, most of rooftop farming projects are not involved too much construction or landscape design knowledge, landscapers are playing a weak role in this process, moreover, because Expert_2 is a landscaper as well, hence I didn't set a planning/ constructions group specifically. Secondly, for planning lawyer group, because I formulated a sub interview question regarding to legal framework

context, I can get information about relevant law from each stakeholders and documents which I presented in Results chapter. It's why I don't have planning lawyer group. Lastly, the other two articles both set a sales/ distribution group, but in Shanghai, the initiators don't see rooftop farming as a food production project and don't make profit by selling food products either, hence the distribution section has not been involved in the rooftop farming development process.

The general perception towards urban agriculture and rooftop farming

In this aspect, my research findings are quite similar with the cases of Berlin and Barcelona. The majority of stakeholders consider urban agriculture and rooftop farming as a social or education tool rather than actual food provision. Sanyé-Mengual et al. (2016) conclude in their paper that the main driver of urban agriculture in Barcelona is addressing social demands instead of improving food production, however they believe altering the driver of urban agriculture into productive urban agriculture is able to stimulate rooftop farming development. My findings shows it also suits the context of China. Because, if most of stakeholders deem urban agriculture or rooftop farming as a social or education instrument, it means the number of urban agriculture or rooftop farming projects may not have to be in a large scale and they are replaceable by other social or educational forms, as a consequence, the rooftop farming development may be extremely constrained. On the contrary, if urban agriculture or rooftop farming is considered as a great solution to improve food production by majorities, then they may concentrate on increasing rooftop farms scale, as only when the implemented area is large enough, it becomes possible to contribute to the food production.

Perceived benefits

Referring to Specht et al. (2016)'s paper, I structure 4 categories to classify perceived benefits. In general, all of stakeholder acknowledge the major potential benefits of rooftop farming is its social benefits. Nonetheless, for economic and environmental benefits, different types of stakeholders may have different inclination due to their various motivations. Business man care more about its economic benefits than its positive environmental impacts, whereas governors and experts believe its environment effects should get more attentions. Aesthetic benefits of rooftop farming poorly affect rooftop farming development, according to stakeholders' opinions.

I extract 6 social benefits from the conversations with relevant stakeholders. Comparing to international context, there are two main differences. Firstly, in the case of Berlin, the authors present improved food quality as a social benefits (Specht et al., 2016) , but in the case of Shanghai, stakeholders didn't specialize the food quality of rooftop farm products. Secondly, shortening the distance between the enterprise and citizens is another social benefit metioned by stakeholders in the case. Some enterprises are located at communities, rooftop farms on

company buildings can be an instrument to create communication opportunity between enterprises and citizens. In addition, in other researches regarding urban agriculture, some authors present that urban agriculture has a huge potential to improve community food security (Altieri et al., 1999) and self-sufficiency rate of food supply (Bryld, 2003). Stakeholders of my case didn't point at these two benefits, they think Shanghai is surrounded by farming lands and logistics network is very convenient in China, so food supply is not a prominent problem for Shanghai. Meanwhile, interviewers think food security can be guaranteed by food regulation system, if the system is complete enough and can monitor the food security in entire food chain from food production to food consume.

Concerning environmental benefits, the most important benefits and two 'important' benefits concluded from interviews are increasing urban greening area, lowering urban heat island effect and improving air quality. However, the three benefits are not mentioned in the case of Berlin. Cui and Shi (2012) describe that the temperature differences between urban and rural areas are significantly increasing due to rapid urbanization, and air pollution is also a serious issue needing to be tackled. However, they also state that increasing urban greening area can mitigate the climate and air quality issues. Therefore, these three environmental benefits are more obvious in the horizons of Chinese stakeholders. In the context of Berlin, because the stakeholders reach a consensus that rooftop green house is best choice of Berlin ZFarming development in advance, the direct positive benefits for the urban environment of rooftop vegetations will be neglected by their selected stakeholders.

In the aspect of economic benefits, the primary difference is that Specht et al. (2016) and Sanyé-Mengual et al. (2016) rooftop farming can provide an opportunity for abandoned buildings, however, in Shanghai, it is rarely seen an abandoned buildings in urban area, in addition, realizing financial self-sufficiency is still a problem troubling Shanghai's stakeholder. Therefore, it is hard to say rooftop farming is able to save an abandoned building.

Perceived risks

The perceived risks and problems are listed from the aspects of technology, social, economic, environmental and aesthetic. Comparing to perceived benefits, the interviewed stakeholders in Shanghai think its risks are generally less important than its benefits. They repeatedly emphasize many risks can be avoided by mature technologies and management system, but if the if the projects are not managed properly, the risks and problems will occur. This opinion is similar with international context. Except that, there are several interesting points differing from international context.

In terms of technology aspect, international stakeholders are worrying about the technocracy level probably is too high (Specht et al., 2016), nonetheless, the Chinese stakeholders are

concerning the risk of low technology threshold. Chinses stakeholders deem the rooftop farming technology is not difficult to be replicated, if the technology threshold is too low, the quality of implementors will be hard to be safeguarded, which definitely will bring some chaos to this Industry. However, the worry about too high technocracy level is also reasonable as it may constrain the popularization of rooftop farming development. Therefore, the technocracy level should be controlled properly. In other words, a standard technical guideline is supposed to be clarified. The content of the technical guideline should cover the technical standards of building a rooftop farm, for example, the standard of soil quality, standard of temperature requirement and standard of plants types.

For social risks, it is quite different from the context of international. Especially, projects are abandoned and resources are wasted and food safety risk, these two points are not mentioned in the case of Berlin or Barcelona. Rooftop may be abandoned for two main reasons. First one is projects are failed and investor or imitator lost motivation to maintain it. The second one is projects are imitated by government and regarded as a tool of showing some governor's achievement and innovation ability in his governing career. In this situation, the rooftop farming becomes a political instrument and it is unsustainable due to frequent governor turnover. Furthermore, food safety risk is the other worry Chinese stakeholders have mentioned. Differing from Berlin's case, Chinese stakeholders are not worrying about the health risk due to air pollution or contaminated waste water caused by rooftop farming activity, but care about the potential risk about poisoning. They imagine that when the rooftop farming become a very popular activity, residents must have high accessibility to any rooftop farm, but it will be also convenient for some criminals to revenge society via poisoning the crops. I think this worry is not redundant, because it is a consequence caused by the contradiction between accessibility and safety risk. Only when this risk is taken in to account in the process of rooftop farming development, stakeholders are possible to find out a solution to prevent potential tragedy from happening.

In general, stakeholders believe all of the environmental risks can be avoided by mature technology in the case of Shanghai. In the case of international cities, the environmental barriers are also less important, but there is an interesting point illustrated by Sanyé-Mengual et al. (2016), they point at rooftop farming development may compete with solar energy. I think this distinction is mainly caused by the solar energy development difference between China and Europe. In China, the solar energy is usually used for domestic water heating rather than electricity production, because most rooftop farm are built on the public or commercial buildings top, solar energy equipment is not needed by them. Therefore, the competition with solar energy is not perceived by Chinese stakeholders.

Economic and aesthetic risks of two contexts are almost same, the only difference is that in my

findings, stink smell of fertilizers is considered as an aesthetic risk in the case of Berlin, while it is classified as an environmental problem in Shanghai.

Promoting contextual factors

The differences of promoting contextual factors between Shanghai and Berlin cases are concentrated on the aspects of market situation and innovation process. In my research, I find Chinese education market has a huge potential, which will promote the development of rooftop farming as its educational function is acknowledged by most of people. Chinese parents are extremely willing to invest for their children's education, and nature education is one of most important elements. Because of high urbanization of Shanghai, the kids born in urban are have limited opportunities to acquire nature or farming knowledge, which becomes an important reason why their parents or school desire to make up this knowledge gap for the children with the help of rooftop farming. The other apparent distinction is in the aspect of innovation process. In Berlin, interdisciplinary stakeholder networks are established, which is very helpful for stimulating innovation. (Specht et al., 2016) However, in Shanghai, initiators of rooftop farm have to establish their own network individually. It means, if some initiators have weak human resource integration ability, they will have more possibility to fail. In addition, because the network is lacked, the necessary communications between various stakeholders are missing as well.

Hindering contextual factors

Concerning political context, few political support is considered as a hindering contextual factor in Shanghai, but this point is debatable by stakeholders. On the one hand, stakeholders admit specific political regarding rooftop farming is truly lacked in Shanghai, whereas experts deem if government does not forbid the development of rooftop farming, lacked political support should not be regarded as a hindering factor. On the other hand, governor thinks although they don't formulate particular policies encouraging rooftop farming, they do have other policies funding urban agriculture and city greening projects. I believe the lack of necessary communications between government and initiators is the main reason why stakeholders perceive this factor.

In terms of legal framework, the special condition in China is the food products are illegal to sell without sales qualification, however, the process of applying this qualification is quite complex. In Berlin and Barcelona cases, consumers are willing to buy is concluded as a promoting factor. In China, most of initiators are unwilling to take this risk to sell their products, which indirectly weakens the food production significance of rooftop farming.

The rest differences between China and Europe exist in the aspects of market situation and

spatial context. The prominent hindering factor of market situation in Shanghai is consumers cannot insist on urban farming activities. The excuse of consumers are they are too busy to participate in rooftop farming activities, while the understanding of initiators are consumers lost passion and interest in rooftop farming gradually. In my view, I think the essential reason is most of Chinese consumers are not fond of farming from the bottom of their hearts and they don't regard farming as a relaxing activity or a meaningful part of their life. This is different from thoughts of the foreigner urban farmers in Shanghai, they started to reach out farming or gardening since they were kids, tutored and influenced by their parents. As a result, they think farming or gardening has become an indivisible part of their life. I believe it can also explain why this point does not exist in case of Europe. A remarkable factor of spatial context in Shanghai is that climate condition is not very suitable for rooftop farming. Unlike Mediterranean climate in Barcelona, Shanghai's climate is more extreme. Especially in summer, the highest temperature may exceed 40 degrees, it is almost impossible to activate on a rooftop.

5.2 Reflections on interesting points of this research

In the process of research, I found several interesting points that are worth being discussed. In this section I will reflect on three points, which may bring some insights about the results.

The importance of mutual interference between stakeholders

In this research, the focus of this paper is to research the importance of the individual stakeholder perceptions. However, mutual interference of them is also important. For instance, the relationship between initiator stakeholders and client stakeholders is service provider and customers. The perception of customers will directly affect the business of service provider. If client stakeholders always complain the conditions of rooftop farm, it will press initiators have to make a choice, improving the shortcoming and satisfying clients or closing their farms. If the contradiction between initiators and clients was enlarged, the mutual interference of them will influence the rooftop farming development process. Similarly, the mutual interference between administrative stakeholders and initiators are also important. If these two groups of stakeholders can well understand each other and keep a healthy cooperative relation, their impacts on rooftop farming will be more powerful. However, if they always complain and misunderstand mutually, it may affect the effects of communication, causing a negative effect on rooftop farming development.

Positive side of risks and problems

The risks and problems of rooftop farming have negative effects on rooftop farming development. However, the positive side of these factors cannot be neglected. The risks were perceived by stakeholders, which also means these risks are known by them. As a result, these

existing risks will trigger stakeholders improve awareness of managing risks in the initiatives. For instance, one stakeholder was worrying about the food security of rooftop farm. She said potential criminals may easily poison the food because of high accessibility. It is a risk of rooftop farm, but after it has been perceived by stakeholders, people's guard consciousness was also improved. The risk will trigger stakeholders to figure out a particular solution to avoid the risk. The positive side of risks and problems is that they have significance of pressing the progress of rooftop farming development. The rooftop farming initiative can become mature in the process of discovering problem and solving problem.

High scoring factors

There are only three factors were defined as "very important" in the results. They are perceived social benefit of farming and natural education, perceived environmental benefit of increasing urban greening space and perceived promoting contextual factor of the education demand in terms of market situation. This environmental is direct significance of rooftop farming, as crops or vegetables are green plants essentially. The other two high scoring are closely related. Most of people agree rooftop farming has the benefit of educating people, therefore, many people will regard rooftop farm as a good educational product. Moreover, in China, the education market is huge. People are always looking for good educational product, which gives rooftop farming an opportunity to develop and widely spread. In other words, the educational benefit of rooftop farming makes it can be promoted in the huge education demand context.

5.3 Limitation of the research

The number of administrative stakeholders is not enough (the limitation of credibility)

I have tried many times to get into touch with government officers during the field work. Unfortunately, almost all of officers reject my interview requests except one officer from Shanghai agriculture commission is willing to accept my telephone interview. Because rooftop farming is a new interdisciplinary industry, it may relate to various government dimensions' work, interviewing and gather different opinions from various governors are helpful for ensuring research results are comprehensive enough. Moreover, government's perspective and attitude will have a significant impact on rooftop farming development, and their policies are often misunderstood or neglect by other stakeholders, thus I desire to hear more explanations from the side of government. However, I am only able to interview one government staff, which may cause an incomplete result.

The case of Shanghai may not completely represent the context of China (the limitation of transferability)

On the one hand, there is a limitation of transferability to other cities in China. Due to time

limitation, I only can select a most representative case of China to explore the development of rooftop farming. However, although Shanghai is a typical Chinese city and rooftop farming is developing earlier that other regions, some conditions of Shanghai may be too special to represent other areas. For instance, the stakeholders in Shanghai think food scarcity and food supply are not problems for Shanghai, thus the food production function of urban agriculture or rooftop farming is not getting enough attentions. Nonetheless, in the other regions of China, the local food production level may be largely lower and logistic network condition is not strong as Shanghai. In this situation, increasing food supply self-sufficiency may become a driver of rooftop farming development. In addition, for example, climate condition is a hindering factor for Shanghai, but for other area, climate condition may turn into a promoting factor. Therefore, the situation of Shanghai may not be completely suitable for other cities in China.

On the other hand, there is also a limitation of transferability to other international contexts. The perceptions conclude in this paper mainly base on the context of China. For instance, the political context, spatial context and legal framework in China is different in other international contexts. In China, the climate conditions of most places are not suitable for plants growth in the winter, which will restrict the development of rooftop farming. However, in mediterranean region, climate is milder in the winter, which have few impacts on rooftop farming activity. There the transferability from China context to other international context is a limitation of this research.

The limitation of comparability

In the first part of discussion chapter, the findings of this paper were compared with finds in international context. However, because many conditions of two contexts are different, the comparability of two cases have limitation. In this section, I will describe the potential limitation.

First of all, I mentioned in the previous section, the stakeholder group composition of two cases are different. This fact may cause the perceptions of stakeholders in two cases are asymmetric. For example, in the case of Berlin, researchers set a food sale and distribution stakeholder group. Therefore, they got many results regarding food sales, such as the economic benefit of selling food, the economic risk of competition with rural farmers and market promoting context factor of people are willing to buy. However, in my case, the qualification of selling food product is too complex to apply, and most of initiators give up selling food to make profit, hence I didn't specifically set a food sale stakeholder group. This is the direct reason that the factors regarding food sales in Berlin case did not exist in my case. The limitation of it is these factors may also appear in case of Shanghai in the future if food sale is a common behavior of initiators, but I did not conclude these factors in my results.

Secondly, the context of China and western countries are different, especially in political context. In China, governments prefer to focus on the current situation of the society, even the governmental master plan is only valid until 5 years in the future. Comparing to China, western government have further vision about the potential problems may appear in the future. The difference will cause different attitude of government regarding food problems. Because, no matter in China or western countries, food scarcity is not an urgent problem currently. As a result, Chinese government do not want to pay too much attention on solving this problem, as they care more about current urgent social problems. This fact may also affect other stakeholders' perceptions on rooftop farming issue. The different political context in two cases may cause the difference of the results. I think it is also a limitation of comparability.

Lastly, the results were only compared with Berlin's case. It is a limitation of comparison. It is restricted by limited number of academic researches regarding perceptions of stakeholders on rooftop farming issue. However, the conditions of other countries may be also different from China and Germen. The knowledge gap of this topic cannot be fully filled, as only two cases were compared and their transferability is not enough.

The limitation of concept used in the paper

The concept used in this paper is mainly the 'acceptance theory'. The framework of this theory is focused on the perceived information from stakeholder, for example perceived benefit, risk and contextual factors. However, the limitation of this framework is the perceptions of stakeholders to other stakeholders were neglected. Although in the process of interview some stakeholders also mentioned their opinions to other stakeholders, I didn't include this question in the interview protocol. It caused that I cannot collect comprehensive data regarding this topic. It's a limitation because the mutual inference between different stakeholders may also influence the development of rooftop farming.

6. Conclusion

The stakeholders' perceptions and social acceptance study is very crucial before a new technology or product to be introduced to more people. As a new form of urban agriculture, the success or failure of rooftop farming will be influenced by relevant stakeholders' perceptions. In general, the perceived benefits and promoting contextual factors will have a positive impact on rooftop farming development, whereas, perceived risks and hindering contextual may lower the success possibility of rooftop farming. One the one hand, this thesis reveals the most important benefits of rooftop farming in Shanghai distribute in social, environmental and economic aspects. The social benefits of farming and natural education and improving citizens' awareness, the environmental benefits of increasing urban greening area, lowering urban heat island effect and improving air quality, and the economic benefit, new business model and opportunities, are 5 most important perceived benefits. In addition, stakeholders think government cares about ecological civilization development, the education demand in the market and current legal framework is unclear are three most significant contextual factors that may promote rooftop farming development in Shanghai. These perceived benefits and contextual factors can increase the social acceptance of rooftop farming and they are the main reasons that probably cause rooftop farming success in the future. On the other hand, there are also some important risks and hindering contextual factors needed to be noted. The most crucial risk of rooftop farming is perceived as limited or no economic profits. This is a primary risk may lead to the loss of interests and attentions from initiators and funders. Furthermore, limited political support, negative consumers sustainability and bad climate conditions are three very important contextual factors that probably hinder the rooftop farming development. These perceived risks and hindering contextual factors may decrease the social acceptance of rooftop farming and increase the probability of failure.

Scientific recommendations

In the process of research, there are several points can be interesting topics for further academic research.

Firstly, I find the misunderstanding and contradiction between government and other stakeholders is an interesting point. However, because my research objective is to identify perceived benefits and risks of rooftop farming, this point is excluded in my research range. This point can be a recommendation for future research, to study how government communicate with other relevant stakeholders and what are the shortcomings in this process.

Secondly, one of the limitations of this paper is the transferability from case of Shanghai to other cities in China. Because the academic research of rooftop farming in other cities has not been conducted, the conditions of other Chinese cities are unknown. It will be an interesting topic to

explore the perceptions of stakeholders in other regions and through comparing with Shanghai case to conclude the similarities and differences.

Thirdly, the governance mode of rooftop farming is another interesting topic. In Shanghai, most of rooftop farming initiatives are starting from bottom. The effect and influence of top-down governance mode is unknown. Through comparing and analyzing the differences between bottom-up and top-down governance method will help policy makers to make a more proper decision.

Lastly, in case of Shanghai, the rooftop farms on the residential buildings are lacked. Although there are many problems to implement rooftop farming on residential buildings, such as the problem of property, or contradictions between neighbors, the possibility of it is still existing. In further scientific study, focusing on the issue of rooftop farming on residential buildings maybe a choice.

Societal recommendations

According to findings of this paper. There are some societal recommendations may promote the development of rooftop farming.

Firstly, many stakeholders complained they can barely get support from government. For government, the limited budget maybe a reason why they didn't hand out any subsides for rooftop farming project. However, the government can refer to their policies for other initiatives. For instance, government reduced tax of museums to support the development of museum culture. Similarly, this policy also can be implemented on rooftop farming project, which will lighten burdens of many initiators.

Secondly, the interaction between rooftop farming imitators and experts should be more. In the process of interview, I found initiators have mentioned they waste lots of time because they have limited professional knowledge on agriculture or landscape. If the relevant experts in universities are willing to provide consultation for these initiators, it will extremely speed up the development of rooftop farming. And many unnecessary problems will be avoided with the help of professional experts.

Thirdly, in the case of Berlin and Barcelona, there are some initiatives about rooftop greenhouse. However, in Shanghai, there is no similar case. The rooftop greenhouse maybe a successful try, because it is one type of agriculture and the greenhouse can mitigate the negative effects of climate conditions. In Shanghai, summer is too hot and winter is too cold for people to do farming activity on rooftop, but the greenhouse initiative will address this problem and prolong the proper time of farming for customers.

Lastly, in this paper, a number of risks and hindering contextual factor were concluded. Relevant stakeholders who involved in rooftop farming should pay more attention on these problems and improve their awareness of managing risks. In the process of building and operating rooftop farms,

initiators should care about the its potential environmental problems, implement proper water-proof and dust-proof initiatives. Policy makers are supposed to cooperate with other stakeholders to make a better context that is good for rooftop farming development.

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Abbreviations

RF- rooftop farming

RTEG- rooftop eco greenhouse

UA- urban agriculture

URF- urban rooftop farming

ZFarming- Zero-acreage farming

Annex.1 The interview content list

Master graduation project
Shanghai rooftop farming investigation

Opening: Nice to meet you, XX. I'm a master student from Wageningen University in Netherlands, my name is Bu Yuting. Currently, I'm doing my master graduation project concerning stakeholders perceptions study of rooftop farming development in Shanghai. It's my honor that I have the opportunity to interview you and listen to your rich experience and unique understanding towards rooftop farming issue. Before we start the interview, I'm wondering if I can use my cell phone to record the audio of our conversation. Please don't worry, the recording will only be used as my academic study and I will fully respect and protect your privacy. All of the content of our conversation will be literally recorded and your response to this interview will be kept anonymous in the thesis.

Personal information

1. First of all, please introduce yourself briefly, including your position and background.

2. Can you talk about what's your relation to rooftop farming *(*clarify different types of stakeholders in the interview)*? And what's your experience on rooftop farming?

*(*If the interviewee is involved in some particular rooftop farming project, then also ask some information about this project, such as business mode, development history and current situation)*

General perception and conceptualization*(*explain the reason why I ask this question)*

3. How do you define urban agriculture from your perspective?
   - *What do you think the functions and significance of urban agriculture?*
   - *What do you think the current situation of urban agriculture development in Shanghai?*

4. How do you define rooftop farming from your perspective?
   - *What do think the functions and significance of rooftop farming?*
   - *What do you think the current situation of rooftop farming in Shanghai?*
   - *What do you think the relation between urban agriculture and rooftop farming?*

Perceived benefits, risks and problems

5. In your view, what are the benefits and risks or problems of rooftop farming development in Shanghai? Can you specify your answer from the these aspects:
   - *Social aspect?*
   - *Economic aspect?*
   - *Environmental aspect?*
   - *Aesthetic aspect?*

*(*The interviewee was asked to assign the weight (scale: 1-5, 1 means least important, 5 means most important) of every factor the they mentioned in the interview)*

Contextual factors

6. In your opinion, what are contextual factors that can promote or hinder the development of rooftop farming in Shanghai? Can you specify your answer from these aspects:?

- *perspectives of Political context (e.g. government's attitudes and policies)*
- *Legal context (e.g. relevant bylaws)*
- *Spatial context (e.g. land use)*
- *Market situation (e.g. market phenomenon and consumers reaction)*
- *Innovation process (e.g. innovation context and phenomenon)*

*(*The interviewee was asked to assign the weight (scale: 1-5, 1 means least important, 5 means most important) of every factor the they mentioned in the interview)*

Snowballing

7. Do you know any other stakeholders who are also involved in rooftop farming development process in Shanghai? Could you please share their contact information with me?

Last question

8. Could you please conclude your expectations towards the rooftop farming development in Shanghai, or is there any other relevant issue also concerning rooftop farming you want to share with me?

Ending: I really appreciate that you agree to take this interview and share your experience and opinions with me. The whole conversation is very pleasant and I learnt a lot from it. I will transfer the content of our conversations into transcript later. If you need, I am willing the send transcripts to you for double check. And if you have any confusions or requirements about this interview, do not hesitate to contact me.

Annex.2 The specific perceived benefits factor distribution and importance scale calculation

Perceived benefits	Distribution of interviewee and weighting (scale 1-5)	Weighting average	Occurrence frequency	Score	Importance
Social_1	Expert_1 (5) Expert_2 (5) Initiator _1 (5) Initiator_2 (5) Initiator _3 (4) Client_1 (5) Client_2 (4) Client_3 (5) Client_4 (5) Administration_1 (4) Unions_2 (5)	4.81	11	53	AAA
Social_2	Expert_1 (5) Initiator _1 (4) Initiator_2 (4) Initiator _3 (4) Client_1 (5) Client_2 (3) Client_3 (5) Client_4 (5) Administration_1 (3)	4.22	9	38	AA
Social_3	Expert_1 (4) Initiator _1 (5) Client_1 (4) Unions_1 (4) Unions_2 (5)	4.4	5	22	AA
Social_4	Expert_1 (3) Expert_2 (3) Initiator_2 (4) Initiator _3 (4) Client_3 (4)	3.6	5	18	A
Social_5	Expert_1 (4)	4	1	4	A
Social_6	Initiator_1 (5)	5	1	5	A

Envrionmental_1	Expert_1 (5) Expert_2 (5) Initiator _1 (3) Initiator_2 (4) Initiator _3 (3) Client_1 (4) Client_2 (2) Client_3 (3) Administration_1 (5) Unions_1 (4) Unions_2 (4)	3.81	11	42	AAA
Envrionmental_2	Expert_1 (5) Expert_2 (5) Initiator _1 (4) Initiator_2 (5) Initiator _3 (4) Client_1 (4) Administration_1 (5) Unions_1 (4) Unions_2 (4)	4.44	9	40	AA
Envrionmental_3	Expert_1 (5) Expert_2 (5) Initiator _1 (3) Initiator_2 (4) Client_1 (4) Client_2 (4) Administration_1 (4) Unions_1 (3) Unions_2 (3)	3.89	9	35	AA
Envrionmental_4	Expert_1 (5) Expert_2 (5) Initiator _1 (5)	5	3	15	A
Envrionmental_5	Expert_1 (3)	3	1	3	A
Envrionmental_6	Expert_1 (3)	3	1	3	A
Envrionmental_7	Unions_2(3)	3	1	3	A
Economic_1	Expert_1 (1) Expert_2 (3) Initiator _1 (5) Initiator_2 (4) Initiator _3 (5) Client_1 (5)	3.7	10	37	AA

	Client_2 (4) Administration_1 (4) Unions_1 (3) Unions_2 (3)				
Economic_2	Client_3 (5) Initiator_2 (5)	5	2	10	A
Economic_3	Initiator_3 (5)	5	1	5	A
Aesthetic_1	Expert_1 (3) Expert_2 (1) Initiator _1 (2) Initiator_2 (2) Client_3 (3) Unions_1 (1) Unions_2 (2)	2	7	14	A
Aesthetic_2	Expert_1 (3) Initiator _3 (2) Unions_1 (1)	2	3	6	A

Annex.3 The specific perceived risks factor distribution and importance scale calculation

Perceived risks	Distribution of interviewee and weighting (scale 1-5)	Weighting average	Occurrence frequency	Score	Importance
Technology_1	Initiator_1 (4) Initiator_3 (3)	3.5	2	7	A
Social_1	Expert_1 (5) Expert_2 (4) Initiator _1 (4) Unions_2 (5)	4.5	4	18	A
Social_2	Initiator_2 (4) Administration_1 (3)	3.5	2	7	A
Social_3	Expert_1 (2) Initiator _1 (2) Client_2 (2) Administration_1 (3) Unions_1 (3) Unions_2 (2)	2.33	6	14	A
Social_4	Initiator_1 (4)	4	1	4	A
Envrionmental_1	Expert_1 (2) Expert_2 (2)	2	2	4	A
Envrionmental_2	Expert_1 (1) Expert_2 (1) Initiator _1 (1) Initiator_2 (1) Client_2 (2) Unions_2 (1)	1.4	5	7	A
Envrionmental_3	Client_1 (2) Client_2 (3) Unions_1 (1) Unions_2 (1)	1.75	4	7	A
Envrionmental_4	Initiator _1 (2)	2	1	2	A
Economic_1	Expert_1 (3) Expert_2 (2) Initiator _1 (5) Initiator_2 (5) Initiator _3 (5) Client_1 (5)	3.89	9	35	AA

	Administration_1(4) Unions_1 (3) Unions_2 (3)				
Economic_2	Expert_1 (4) Expert_2 (3) Initiator _1 (4) Initiator_2 (5) Initiator _3 (5) Client_3 (4) Unions_2 (3)	4	7	28	AA
Economic_3	Expert_1 (2) Expert_2 (2) Initiator _1 (4) Initiator_2 (3) Initiator _3 (5) Client_3 (4) Unions_2 (3)	3.29	7	23	AA
Aesthetic_1	Expert_2 (1) Initiator _1 (2) Initiator_2 (2) Unions_1 (1) Unions_2 (2)	1.6	5	8	A

Annex.4 The specific perceived promoting contextual factor distribution and importance scale calculation

Perceived promoting contextual factor	Distribution of interviewee and weighting (scale 1-5)	Weighting average	Occurrence frequency	Score	Importance
Political context_1	Expert_1 (5) Expert_2 (5) Initiator _1 (4) Initiator_2 (3) Initiator _3 (2) Client_1 (4) Client_2 (5) Client_3(3) Administration_1 (5)	4	9	36	AA
Market situation_1	Expert_1 (5) Expert_2 (5) Initiator _1 (5) Initiator_2 (5) Initiator _3 (5) Client_1 (5) Client_2 (2) Client_3 (5) Client_4 (5) Administration_1 (4) Unions_2 (4)	4.55	11	50	AAA
Market situation_2	Initiator_3 (5) Client_1 (5) Client_2 (4) Client_4 (5) Unions_2 (4)	4.6	5	23	AA
Legal framework_1	Expert_1 (2) Initiator _1 (2) Client_2 (2) Administration_1 (3) Unions_1 (3) Unions_2 (2)	2.33	6	14	A
Spatial context_1	Expert_1 (5) Expert_2 (5) Initiator _1 (4)	4.2	5	21	AA

	Initiator_2 (3) Administration_1 (4)				
Innovation process_1	Expert_1 (3) Expert_2 (3) Initiator _1 (4) Initiator_2 (3) Initiator_3 (3) Administration_1 (5)	3.5	6	21	AA

Annex.5 The specific perceived hindering contextual factor distribution and importance scale calculation

Perceived hindering contextual factor	Distribution of interviewee and weighting (scale 1-5)	Weighting average	Occurrence frequency	Score	Importance
Political context_1	Expert_1(4) Initiator _1 (5) Initiator_2 (5) Initiator _3 (5) Client_2 (4) Client_3(4) Unions_2 (5) Unions_2 (5)	4.63	8	37	AA
Market situation_1	Expert_1 (5) Initiator _1 (5) Initiator_2 (5) Initiator _3 (5) Client_1 (5) Administration_1 (4) Unions_2 (5) Unions_2 (5)	4.88	8	39	AA
Legal framework_1	Expert_1(4) Expert_2 (3) Initiator _1 (5) Initiator_2 (5) Initiator _3 (5) Client_2 (4) Client_3(4) Unions_2 (3) Unions_2 (4)	4.11	9	37	AA
Legal framework_2	Initiator _1 (4) Client_3 (3)	3.5	2	7	A
Legal framework_3	Expert_2 (4) Initiator _1 (4) Initiator_2 (3) Initiator_3 (3)	3.5	4	14	A
Spatial context_1	Expert_1(4) Expert_2 (4)	3.9	10	39	AA

	Initiator _1 (5) Initiator_2 (5) Initiator _3 (5) Client_1 (3) Client_2 (5) Client_3(4) Unions_2 (2) Unions_2 (2)				
Innovation process_1	Initiator _1 (4) Initiator_2 (4) Initiator _3 (5) Unions_2 (4) Unions_2 (3)	4	5	20	AA