

Understanding the influence of local government strategies targeting creative industries in Bandung, Indonesia, using Agent-Based Modelling

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## Abstract

Creative industries are blooming in the Global-South (Fahmi, McCann, Koster, 2017) as they are potential drivers of job creation, innovation, and social inclusion (UNCTAD, 2010; Lazzarotti & Vecco, 2018). This has caused Indonesia to embrace creative industries and to implement policies focused on the development of its creative industries. These policies are often aimed at specific areas, like cities. One city that embraces creative industries is Bandung. The implementation of such policies makes it of importance to policy makers to understand to what extent the policy strategies ensure that the policy goals are achieved. Therefore, this study aims to assess the impacts of local government strategies on the development of creative industries in Bandung, Indonesia.

Three research questions were set up to guide the process: “*What are the policy actions of the local government policy strategies that are used to stimulate the development of creative industries?*”, “*What characteristics of creative firms and their environment are of importance for the development of creative firms?*”, and “*What is the impact of the local government strategies on the development of creative firms?*” To achieve the research aim, an agent-based model was set up and a scenario-based analysis was performed. Survey data and literature were used to set up the agent-based model. Three of the most recent and relevant local government policies aimed at creative industries in Bandung have been reviewed to set up scenarios for the analysis. This led to the baseline scenario, the industrial centres development scenario and the tourism development scenario. An average nearest neighbour analysis and a Moran’s I analysis were conducted to analyse the spatial patterns. Lastly, the number of bankrupt creative firms have been analysed.

The scenario-analysis showed that the implementation of the policy actions caused clustering of creative firms. In all scenarios, this clustering was based on their main product. The tourism scenario also showed clustering based on the customer target. In addition, the results showed that the policy actions that are directly aimed at creative firms, e.g., offer financing and workshops, impacted the development of creative firms as they caused more creative firms to establish and less creative firms to go bankrupt. The policy actions that are indirectly aimed at creative firms, e.g., establishing a festival and developing creative tourism programmes, impacted the development of creative firms as they caused more firms to go bankrupt. This research showed that the following policy actions are deemed the best for creative industry development: improving financing access, providing financial subsidies, offering training, and offering workshops. These policy actions are recommended to be included in the policy strategies aimed at the development of creative industries.



## Preface and acknowledgements

Before you lies the thesis “Understanding the influence of local government strategies targeting creative industries in Bandung, Indonesia, using Agent-Based Modelling”. This thesis has been written as part of the master program Geographical Information Management & Applications (GIMA) and was conducted between September 2021 until March 2022. I always found agent-based modelling interesting and here I finally got the chance to learn more about this and develop a model from scratch myself.

My interest in this topic is not surprising as my mother was born and raised in Indonesia. From the moment I read about this topic I was intrigued and after speaking with Judith I knew I wanted to dive into this topic. When I am able to visit this beautiful country again, I sure will try to visit Bandung and see everything I read about in real life.

I would like to thank my supervisors Judith and Mafalda from the bottom of my heart for their guidance and support during this process. Judith, thank you for helping me when I struggled with the programming and conceptualizing of the model. Mafalda, thank you for teaching me so much about creative industries and your enthusiasm for this topic. Also, I would like to thank Ana for enthusiastically showing and explaining the INECIS data in great detail to me.

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I hope you enjoy reading this thesis and hopefully learn something new from it.

Mandy Bron  
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# 1. Introduction

## 1.1 Context

Creative industries are seen as a feasible development option for countries as they offer opportunities for socio-economic development of neighbourhoods (Booyens, 2012). The term creative industry originates in Australia and refers to industries which have their origin in individual creativity, skill, and talent and which have a potential for wealth and job creation through the generation and exploitation of intellectual property (DCMS, 2001). Since its booming in Australia, the United States, Canada, and Europe, it is argued that the creative economy is highly successful in the Global-North (Lazzeretti & Vecco, 2018). In the past decades, creative economies have also been spreading across the Global-South, since they are potential drivers of job creation, innovation, and social inclusion (UNCTAD, 2010; Lazzeretti & Vecco, 2018).

An example of a Global-South country where the creative economy has emerged is Indonesia. Indonesia has a diverse culture and large population, which gives its creative industries potential. To stimulate the development of the creative economy in Indonesia, the Presidential Instruction number 6 was issued in 2009 (Hidayat & Asmara, 2017). The aim of the Presidential Instruction is to encourage local governments to include the creative economy as part of their development agendas. Policies on the creative economy at the national level include the above-mentioned Presidential Instruction as well as long-term and mid-term action plans for the creative economy (Ministry of Tourism and Creative Economy, 2014). At the local level, the creative economy is used as a tool for urban economic development and usually included in local development plans (called RPJPDs and RPJMDs).

The blooming of creative industries in the Global-South and the promotion of creative industries in Indonesia specifically has caused several Indonesian cities to embrace creative industries and creative city discourses (Fahmi, McCann, Koster, 2017). In these cities you often find specific types of neighbourhoods, called *kampung*s, that host activities with a creative industry profile and potential. One city that embraces the creative industries is Bandung. Bandung is the third largest city in Indonesia and has seen a growth in its creative industries ever since its emergence in the mid-2000s (Fahmi et al., 2017). In 2015, UNESCO officially named Bandung as a creative city (Chan & Raharja, 2018). In this city, several local government policies and strategies from different agencies are present. In 2015, the Bandung Creative Centre (BCC) was launched as a centre of (inter)national stakeholders to encourage the exchange of creative experiences and ideas (Chan & Raharja, 2018).

## 1.2 Relevance and research aim

Research on cultural and creative industries is of growing importance, as creative industries are increasingly getting acknowledged as a driver for economic development, urban economic growth, and as a source of innovation in both the local and regional context (De-Miguel-Molina, Hervas-Oliver, Boix & De-Miguel-Molina, 2012; Lee & Rodriguez-Pose, 2014; Jones, Lorenzen & Sapsed, 2015; Potts 2016). Current research on creative industries is focused on identifying links between the different actors involved in the development and implementation of creative industry strategies (Astuti, Permana, Qomarun & Andisetyana, 2017; Kourtit & Nijkamp, 2019; Borseková, Vaňová, Šúrová, Král, Turečková, Nevima & Martinát, 2021). However, it is yet unclear how, and if, the behaviour of these actors is influenced by strategies and actions of the local government. This thesis addresses this research gap. In addition, current research is often focused on the Global-North and little research is to be found in the context of the Global-South (Yusuf & Nabeshima, 2005; Aritenang, Iskandar & Safitri, 2020). Indonesia is in the Global-South, which makes this research an addition to the current research that has been done on local government strategies in the context of the Global-South.

Indonesia embraced creative industries and has implemented several policies focused on their development. This makes it of importance to policy makers to understand to what extent the policy strategies ensure that the policy goals are achieved. The aim of this thesis is the following: *“To assess the impacts of local government strategies on the development of creative industries in Bandung, Indonesia.”* The term “development” is in this research defined as the growth of creative industries. This regards growth in terms of the growth of creative industries as a whole (the amount of creative industry firms in Bandung) and of the growth of creative industry firms as individuals (possible growth in the number of employees and customers per creative industry firm). The results of this thesis show how, and to what extent the local government strategies impact creative industries in Bandung, Indonesia.

To fulfil this aim, a research method that can model both the local government strategies and creative industries in one environment is required. One method that can model real-world systems is agent-based modelling. Bonabeau (2002, p. 7280) gives the following definition of agent-based modelling:



*“In agent-based modelling, a system is modelled as a collection of autonomous decision-making entities called agents. Each agent individually assesses its situation and makes decisions on the basis of a set of rules.”*

This method allows researchers to create, analyse and experiment with agents that operate in an environment created in a model (Abdou, Hamill & Gilbert, 2012). Using agent-based modelling to identify the influence of policies is a common approach (Guzy, Smith, Bolte, Hulse & Gregory, 2008; Gerst, Wang, Roventini, Fagiolo, Dosi, Howarth & Borsuk, 2013; Florent & Enrico, 2015; Moncada, Verstegen, Posada, Junginger, Lukszo, Faaij & Weijnen, 2019). The use of an agent-based model (ABM) is appropriate for this research because it can represent (complex) real-world phenomena that are difficult to capture in the more traditional, mathematical methods like statistical forecasters (Lempert, 2002). Agent-based modelling thus fits the method requirements and is used in this research.

A scenario-analysis is performed to assess the local government strategies. In the ABM of this research, different scenarios are created. Each scenario represents different local government actions that have been implemented in the past years in Bandung. The result of the model runs show how creative industries have evolved during the implementation of the government actions (in terms of foundation, growth, and closure of firms) and what their spatial patterns are (based on the location choice of the firms). The differences between the scenarios and their environment are analysed to assess the impacts of the local government strategies on the development of creative industries.

### **1.3 Research questions**

To reach the aim of the research, three research questions are set up to guide the process. The questions each focus on a different aspect of this research and are as follows:

1. What are the policy actions of the local government policy strategies that are used to stimulate the development of creative industries?
2. What characteristics of creative firms and their environment are of importance for the development of creative firms?
3. What is the impact of the local government strategies on the development of creative firms?

The aim of the first research question is to get an overview of the policy actions of the local government policy strategies that are used to stimulate the development of creative industries. This is needed to understand how the local government tries to influence the development of creative industries. The answer to the second research question provides information on how creative firms develop and which factors play a role in this. To answer the third research question, the policy actions as identified in the first research question and the creative firm characteristics and environment are translated into an ABM. A scenario-based analysis is then performed to research and assess the influence of different policy actions on the development of creative industries.

### **1.4 Outline**

The next chapter provides the theoretical framework, focusing on creative industries, government policies on creative industries and agent-based modelling. Chapter 3 presents the methodology used, the case study areas, data, model design and software. Chapter 4 contains results and the discussion, which is followed by the conclusion in chapter 5. The references are in chapter 6 and the appendices are in chapter 7.



## 2. Theoretical framework

### 2.1 Creative industries

There are several definitions of the creative industries among researchers and practitioners. The most popular definition is from the UK, made by the Department for Culture, Media and Sport (DCMS, 2001). They defined creative industries as 'industries which have their origin in individual creativity, skill and talent and which have a potential for wealth and job creation through the generation and exploitation of intellectual property'. In recent years, concepts such as content industries, intellectual property industries and information industries have also been introduced including slightly different definitions and disciplines, but they all share the common theme of creativity (Abadie, Maghiros & Pascu, 2008; Pang, 2012).

Literature on creative industries and the creative economy has developed recently due to their substantial economic contribution to the world economy (Cooke & Lazzeretti, 2008; Ihani, Syofya, Sari, Mulawarman & Sriyanto, 2020). Creativity and creative-related products are credited with promoting higher added-value and competitive jobs, products, and services (Marco-Serrano, Rausell-Koster & Abeledo-Sanchis, 2014). The cultural and creative industries impact economic growth, economic diversification, job creation, and the development of urban and rural areas (UN, 2008; Booyens, 2012). Their importance as drivers for economic growth can be seen in the increasing employment and regional income figures, especially in urban areas (UNCTAD, 2010; Marco-Serrano et al., 2014; Lazzeretti & Vecco, 2018). This can already be seen in countries in the Global-North, where the creative economy has become a leading component of economic growth, employment, and innovation. Wanting to achieve similar results, several Global-South countries strive to develop creative industries through creative city policies.

Activities in creative industries differ from other activities, like manufacturing activities, in several respects. As creative industries are skill intensive, footloose, and focused on the quality of the labour force, they are drawn to areas where market opportunities and easy access to producer services (like suppliers) are combined with an attractive urban environment (Yusuf & Nabeshima, 2005). This indicates that if the environment of an area is appealing to and/or supports creative industries, it can lead to an increase in the number of creative industry firms and creative industry activities. Environments can have their own specific characteristics in terms of geography, economics, politics, and social organization (Hayati, Utami, Bararatin, Santosa, Weichart & Valent, 2020).

The environment influences the location choice of creative industry firms. For example, Gregory & Rogerson (2018) found in their study that accessibility (to the right space to operate and access to markets) and proximity (proximity to networks, public transport links, and employees) are important environmental factors that influence the location choice of creative firms. Gregory & Rogerson (2018) also found that creative firms cluster (not necessarily from the same creative industry sector) to get a greater internal network. They state that establishing a creative business in close proximity to other creative businesses or supportive institutions has the added benefit that opportunities for spill-over effects arise. For example, clustering makes it possible for firms to work together and easily exchange resources and employees (Asheim & Coenen, 2005; Clare, 2013). Zhong (2012) and Fahmi, Koster & Van Dijk (2016) also conclude that creative firms tend to cluster. Lazzeretti, Capone & Boix (2012) mention this as well and state that creative industry firms try to take advantage of the existing skilled labour market and local suppliers specialised in other creative industry sectors to benefit from local knowledge spillovers.

A term that is often used to describe the concept of the clustering of businesses is related variety. Frenken, van Oort and Verburg (2007) argue that spillovers within a region occur among related sectors. This is the case because spillovers often occur between sectors that draw on similar knowledge or have complementarities in terms of shared competences. This could be the case for creative industries, as the creative industry sectors are related. Frenken et al. (2007) also find that the positive results of knowledge spillovers are higher in regions with related variety, than in regions where there is no related variety. They also hypothesise that related variety spurs employment growth, as new combinations lead to new products, services, and jobs. This hypothesis is confirmed by several studies (Boschma, Minondo & Navarro, 2012; Castaldi, Frenken & Los, 2015; Content & Frenken, 2016). It is thus of essence to be aware of the environmental characteristics in which creative industries are present.

### 2.2 Government strategies targeting creative industries

Since the 1990's, creative industries have risen as a discourse and instrument of policy due to the growing attention among policymakers, academics, activists, and artists worldwide (Banks & O'Connor, 2009; Flew, 2013). In 1997, the United Kingdom became the first country to propose and use the concept and policy of creative industries. In the following years, especially in the Global-North, more



governments started making their own policies and strategies that fit the national goals of developing creative industries in its country. Since then, the role of the creative industries as a driver of innovation and a catalyst for economic transformation has become increasingly important in many countries (Boix-Domènech & Rausell-Köster, 2018). Currently, policies, regulations, and programs to govern the creative economy and its creative industries exist on different scales, from national to provincial and from city-level to local.

In reaction to the increasing importance of creative industries in the Global-North, countries in the Global-South started seeking to enhance their competitiveness worldwide and gain from opportunities presented by the creative economy. As these countries link creative industries with poverty alleviation, basic infrastructure development, the enhancement of social inclusion and the promotion of cultural heritage and diversity (Cunningham 2009; Booyens, 2012), policymakers in the Global South have started to adopt creative industry policies. Two examples are Cape Town (South-Africa), which has embarked on promoting itself as a creative city, and Shanghai, which has been promoting the development of creative and cultural industries (He, 2019; Nkula-Wenz, 2019).

### **2.3 Creative industries in Indonesia**

Creative industries contribute to the economic development in many countries and have been one of Indonesia's drivers for economic development since 2009 (Indonesian Ministry of Trade, 2009). In Indonesia, creative industries are defined by the Indonesian National Creative Economy Agency (BEKRAF) as industries whose innovation and creativity are rooted in the hereditary culture that belongs to the local community (BEKRAF, 2017). In total, there are fourteen sectors in creative industries as defined by the Indonesian Ministry of Trade: architecture; art market; handicraft; design; fashion; video, movie, and photography; interactive games; music; performance art; publishing and printing; computer service and software; television and radio; research and development (Indonesian Ministry of Trade, 2009; Subagja, 2017). In 2013, the contribution of the creative economy on Indonesia's GDP was 7.05 percent (Siswanto & Santoso, 2017). The creative industries in Indonesia have also contributed to the country's employment rate, increasing every year (Indriana, 2019). These contributions are dominated by the culinary, fashion, and craft sectors (Utama & Ratnapuri, 2018).

The creative industries development goal in Indonesia is to expand the country's production and export activities based on local knowledge and resources (Fahmi et al., 2017; Phelps and Wijaya, 2020). In Indonesia, national policies, and regulations to govern the creative economy and its creative industries exist, but there are also provincial, city-level, and local government policies. These policies on a smaller scale are relevant as this enables the possibility to define policy strategies with targeted policy actions that can be implemented.

As the environment (the area in which creative industries are located) plays an important role in the development of creative industries, it is essential to know where the creative sectors are located. In Indonesia, the creative industry sectors are often hosted in *kampungs*, the most frequent form of urban settlements in Indonesia. These are traditional, sometimes unplanned, settlements where diverse people and communities with various cultural, political, economic, and social backgrounds live (Kustiwan, Ukrin & Aulia, 2015; Anindito, Indriansyah, Maula & Akbar, 2019). Policies and policy actions in Indonesia are often targeted at *kampungs* to make them more attractive for creative industries.

### **2.4 Local government strategies in Bandung**

The creative economic sector, along with other supporting sectors, contributes significantly to the economy of Bandung (Creative Cities Network, 2021). The most prominent creative sectors in Bandung are design, handicraft, architecture, music, performance art and research and development. Results from a national survey conducted by BEKRAF and the National Statistics Agency (BPS) even showed that West Java is the province with the most significant exports derived from Indonesia's creative economy sector, with Bandung as one of the most contributing regions (BEKRAF & BPS, 2017).

The first creative *kampung* of Bandung, Kampung Kreatif Dago Pojok, was initiated in 2003 by a local art community (Komunitas Taboo). The government, however, was not involved in this process (Prasetyo and Martin-Iverson, 2013). In 2015, the government (through Ridwan Kamil, the former mayor) stated that Bandung will have thirty creative *kampungs* by 2018. Three of the most recent and relevant policies aimed at the development of the creative industries and creative *kampungs* are discussed.

The first policy is a long-term spatial plan, the Bandung Spatial Plan 2011-2031 (also referred to as RTRW Kota Bandung 2011-2031). In this document, the creative industry is mentioned in the purpose statement: "the purpose of Bandung spatial planning is to actualize safe, comfortable, productive, effective, efficient, sustainable, and environment-friendly space that is also based on the



development of international trade, service, and creative industry”. Next to this long-term policy, there are two short-term policies. These are the Bandung mid-term development plan 2013-2018 and its follow-up, the Bandung mid-term development plan 2018-2023. These policies include the goals and directions for all current developments of creative industries in Bandung city plus strategic issues that are related to the business climate, tourism, and the creative economy (Bustamante Duarte, Pfeffer, Nurman, Aritenang, Rofib, Alfianda, Fahmi, Ramdan, van Harten, Iskandar and Madureira (2020); Aritenang, Iskandar, Safitri, Fahmi, Bustamante Duarte, Pfeffer, Madureira, Ramdan and Nurman, 2021). Maintaining economic growth and the development of industrial centres, creative economy, and small and medium industries are two directions in these plans.

The second policy is the Bandung Tourism Development Master Plan 2012-2025. This plan is used to guide the development of city tourism in terms of regulation, strategies, and programmes that need to be done by stakeholders to fulfil the vision, mission, and the goal of tourism development. The plan encompasses the development of tourism destination, tourism industry, tourism marketing, and tourism institutions. One of the strategies in this policy is to make creative industries as an identity of city tourism (Aritenang et al., 2021). This is done by strengthening the identity of creative industry clusters to become a creative tourism attraction and strengthening the city tourism industry system by establishing linkages with the creative industries of the kampungs (M. Madureira, personal communication, November 2021). In addition, creative tourism programmes are developed.

The third policy is the Bandung City Industrial Development Master Plan 2019-2039. This policy is aimed at the development of small to medium industries that have the characteristics of a sustainable industry (Aritenang et al., 2021). This policy was set up because Bandung is not included in the Industrial Growth Centre Area in the National Industrial Development Master Plan 2015-2035. This resulted in the small to medium industry development being the main alternative for Bandung. Included as policy goals are the growth of the industry sector and of the high added value industry sector. Other goals are improving the number of industrial employments and improving the export value of industrial products of Bandung City. Several strategies have been defined to achieve these goals. Some examples are the development of small new industry clusters and maintaining existing clusters by strengthening institutional capacity of those clusters, improving the utilization of high-value technology and innovation, growing environmental and social awareness, improving the quality of human capital, and fixing regulations and financing methods as affirmative policies to support small industries (Bustamante Duarte et al., 2020; Aritenang et al., 2021).

The content of these policies is divided into three policy goals (table 1). The policy strategies and policy actions that fit into the policy goals are presented as well to summarise the discussed local government strategies in Bandung.



Table 1: Summary of three local government policies in Bandung. Source: Bustamante Duarte, Pfeffer, Nurman, Aritenang, Rofib, Alianda, Fahmi, Ramdan, van Harten, Iskandar and Madureira (2020); Aritenang, Iskandar, Safitri, Fahmi, Bustamante Duarte, Pfeffer, Madureira, Ramdan and Nurman (2021); M. Madureira (personal communication, November 2021).

Policy goals	Policy	Policy strategies	Policy actions
Maintaining economic growth	Bandung Spatial Plan 2011-2031 + Bandung mid-term development plans	<ul style="list-style-type: none"> <li>· Encouraging financial sectors and advanced business actors to help the development of most valuable products and creative industries</li> <li>· Encouraging increased production productivity in the service business sector and creative industries</li> </ul>	<ul style="list-style-type: none"> <li>· Enacting regulations that help the increasing of productivity of service and creative industries</li> <li>· Increasing the quantities and developing the qualities of supporting infrastructures</li> </ul>
Development of industrial centres, creative industry clusters, and small and medium industries	Bandung Spatial Plan 2011-2031 + Bandung mid-term development plans	<ul style="list-style-type: none"> <li>· Increase employment opportunities (number of jobs)</li> <li>· Increasing skilled-labour availability for service and creative industries</li> <li>· Provide assistance in obtaining a business permit (industrial activity permit)</li> </ul>	<ul style="list-style-type: none"> <li>· Provide training (e.g., accounting and specialised training) to promote skilled labour</li> <li>· Simplifying licensing procedures and optimising the use of ICT in licensing services</li> </ul>
	Bandung City Industrial Development Master Plan 2019-2039	<ul style="list-style-type: none"> <li>· Development of human capital</li> <li>· Development of small industries clusters based on industry</li> <li>· Financing</li> <li>· Increase the number of communities and clusters of small and medium industries</li> <li>· Standardization and local product usage improvement</li> </ul>	<ul style="list-style-type: none"> <li>· Developing collaboration between clusters and various stakeholders</li> <li>· Implementing the policy and socialization of local product usage improvement</li> <li>· Improving financing access</li> <li>· Offer technopreneurship training and workshops</li> <li>· Provide financial subsidies, machines, and a financial assistance program</li> <li>· Workshop and advocacy for industrial employees, owners, and agency employees</li> </ul>
Tourism development	Bandung Tourism Development Master Plan 2012-2025	<ul style="list-style-type: none"> <li>· Developing creative industry that is environmentally sound</li> <li>· Increase of tourism in creative kampungs</li> <li>· Improve the development of community's creative industry in product development, management of creative tourism programmes, product marketing and creative tourism programmes</li> <li>· Making creative industry an identity of city tourism</li> <li>· Strengthening the city tourism industry system by establishing linkages with the creative industries of the community</li> <li>· Strengthening the identity of creative industry clusters to be developed as creative tourism attraction</li> </ul>	<ul style="list-style-type: none"> <li>· Developing creative tourism programmes</li> <li>· Improve the quality of tourist destinations by increasing the quantities and qualities of the city's infrastructure</li> <li>· Establish art festivals and knitting contests</li> <li>· Set up a new creative kampung as a tourism area</li> </ul>



## **2.5 Related research on creative industry government policies**

Due to the increasing contributions of creative industries to economies, and the growing number of government policies aimed at creative industries, research on the creative industries and government policies has become of growing importance. The topics have a wide variety. For example, O'Connor & Gu (2014) studied the development of creative industry clusters in Shanghai by looking at the adoption of the creative industries agenda by the Chinese government and Shanghai, and Chaston (2008) examined whether providing training programmes to stimulate business growth is an effective economic regeneration model for small creative industry firms. Another common topic is that of creative industry policies. Menkshi & Braholli (2019) conducted a study in which they mapped and evaluated sectors of the cultural and creative industries in Korça city, Albania. They conclude that cultural and creative sectors are important for generating employment and that policies to develop these sectors should be created. They suggest greater promotion of cultural and creative activities through the organization of fairs, exhibitions, celebrations, special days, and media advertising should be included in these policies. They add that the role of governance is important in stimulating policies for the development of the creative and cultural industries and that the local government should increase subsidies to individuals and other organizations in the cultural and creative industries.

As for research on creative industry policies in Indonesia and Bandung, Herawaty & Raharja (2018) conducted research in which they aimed to formulate the development strategy of the creative industries in Bandung. They used external, internal and competition environments, a SWOT analysis, and functional and business strategies to do so. They conclude that both external and internal factors determine how the strategies are made. They also state that these strategies include the need for collaboration amongst the government, entrepreneurs, and the community to improve the development of creative industries in Bandung. Another research with a focus on the already existing policies is from Raharja & Nurasa (2020). In their recent research, different aspects of the Bandung policy for developing creative industries are analysed. They recommend that the establishment of creative industries can be facilitated by providing technical guidance, training, and capital assistance and by creating business networks. They also recommend that a conducive business climate can be created by developing an information technology infrastructure for maximising the activities of companies. Other research has been done on, for example, how the creative economy discourse is interpreted and implemented in the context of Indonesia (Fahmi et al., 2017) and on the risks of creating policy that supports creative industries in Bandung (Wiryono, Susatyo, Utomo, Suryanta, Sudrajad, Lazuardi & Yuanita, 2015). Most research focuses on the policies themselves, and little on the implementation and the influence of these policies on the development of creative industries.

Currently, there is an ongoing research project entitled INECIS (Informal Economies and Creative Industries Strategies) that explores socio-spatial and economic strategies in Bandung. The main aim of the INECIS project is to rethink the current relationship between government-led strategies and the changes to socio-economic characteristics, land, and tenure security in urban kampungs in Bandung (University of Twente, 2021). The research aim is to analyse the relationship between the informal economies of kampungs and the formal creative industries strategies. How these strategies impact the spatial, social, and economic development of kampungs is included as well. The project started in March 2019 and runs until October 2022. The INECIS research is closely related to this research as the aim of this research is similar to their aim.

## **2.6 Agent-based modelling**

### **2.6.1 Main features and benefits**

In agent-based modelling, a system is represented as a collection of autonomous, self-interested decision-making entities called agents (Bonabeau, 2002) that operate within an environment. Within this environment, each agent is assigned a set of rules and a set of goals. These rules are derived from published literature, expert knowledge or data analysis and are the foundation of an agent's behaviour (Crooks & Heppenstall, 2012). Based on these rules, the agent decides on which action is the best to achieve one of its goals (Sklar, 2007). This feature makes agents autonomous entities, which are capable of processing information. Agents are also able to interact and exchange information with other agents (Crooks & Heppenstall, 2012).

The main feature of agent-based modelling is that interactions between agents can be modelled. This feature enables the possibility to capture emergent phenomena (Bonabeau, 2002). Emergence refers to collective phenomena or behaviours in complex adaptive systems that are not present in their individual parts as they result from the interactions of these individual parts (Bonabeau, 2002; Pines, 2014). Gilbert (2008) mentions this feature of agent-based modelling as the crucial feature



in which agent-based modelling differs from other types of computational models and modelling approaches.

Another key feature is that agents can be modelled individually. Macal & North (2010) state that by modelling agents individually, the full effects of the diversity that exists among different agents in their attributes and behaviours can be observed as it gives rise to the behaviour of the system as a whole. Hall & Virrantaus (2016) confirm this and argue that the understanding of an ABM is not gained from understanding just the behaviour of a single agent but is gained in understanding their behaviour as a collective. This is another feature which distinguishes agent-based modelling from other types of computational models and modelling approaches. For example, in differential equations, all entities are considered equal/uniform (Janssen, 2005).

One more key feature of agent-based modelling is the virtual environment in which the agents operate. Agent-based modelling provides a flexible framework as the environment can be set up in a range from a neutral medium with little to no effects on the agents to a medium that affects the agents greatly. It is also possible to observe patterns in the environment, which can give useful information (Galea, Riddle, & Kaplan, 2010).

Verification and validation are two essential features in the development of an ABM (Klügl, 2008; Ligtenberg, van Lammeren, Bregt & Beulens, 2010; Gräbner, 2018). These methods test the reliability and robustness of the outcomes of the ABM. North & Macal (2007) describe verification as the process of making sure that a model matches its design and behaves as expected. Crooks & Heppenstall (2012) and Gräbner (2018) state that this can be done by checking if the conceptual model is implemented properly. Validation is the process of ensuring that the model adequately represents the real-world system that is being modelled (Casti, 1997). Important to note is that the validity of a model cannot be simplified as valid or invalid. Instead, a model can have a certain degree of validity (Law & Kelton, 1991). There are many methods that can be used to verify a model. Some examples are a sensitivity analysis, in which one changes the values of the input parameters to determine the effect upon the model and its outputs, and a historical data validation, in which one uses historical data (if this exists for the model) to build and test the data (Xiang, Kennedy, Madey & Cabaniss, 2005). Klügl (2008) describes three other validation techniques that can be used. The first is animation assessment, which involves observing the overall visual simulation. The second is immersive assessment, which involves following one agent to see if the agent is behaving as it should. The third is output assessment, which involves checking the model output on consistency and plausibility (Klügl, 2008).

To summarise, agent-based modelling has four main benefits over other modelling techniques. The first benefit is that agent-based modelling provides a natural description of a system. The second is that agent-based modelling captures emergent phenomena through the interaction of agents. The third benefit is that agent-based modelling can represent diversity in behaviour and attribute values of agents. The fourth benefit is that agent-based modelling is flexible as the complexity of the agents can be tuned and the model can be defined in any given system environment. These benefits make agent-based modelling of value in this research. The use of an ABM makes it possible to represent the real-world situation of this research as creative industry firms, their environment, and local government policies can be included.

This method allows researchers to create, analyse and experiment with agents that operate in an environment created in a model (Abdou, Hamill & Gilbert, 2012). Using agent-based modelling to identify the influence of policies is a common approach (Guzy, Smith, Bolte, Hulse & Gregory, 2008; Gerst, Wang, Roventini, Fagiolo, Dosi, Howarth & Borsuk, 2013; Florent & Enrico, 2015; Moncada, Verstegen, Posada, Junginger, Lukszo, Faaij & Weijnen, 2019). The use of an agent-based model (ABM) is appropriate for this research because it can represent (complex) real-world phenomena that are difficult to capture in the more traditional, mathematical methods like statistical forecasters (Lempert, 2002). Agent-based modelling thus fits the method requirements and is used in this research.

### **2.6.2 Limitations**

One aspect that can be considered a limitation of agent-based modelling is that an ABM is a simplification of a real-world system (Janssen, 2005; Gerritsen, 2015). This is the case as the real world consists of many factors and it is impossible to include all factors at the smallest level of detail. It is necessary that the analyst is aware of the assumptions made in the simplification of the real world when drawing conclusions from the model results (Gerritsen, 2015). However, if the analyst builds the model at the right level of abstraction, using the right amount of detail for the model to serve its purpose, this aspect does not have to be considered as a limitation (Couclicis, 2002; Crooks & Heppenstall, 2012).

Another limitation is the so-called curse of dimensionality. In an ABM, every agent can have its own attributes which can potentially be different from the other agents in the model (Gotts, van Voorn,



Polhill, de Jong, Edmonds, Hofstede & Meyer, 2019). This means that the number of model parameters that needs to be tuned and calculated can become enormous. Thus, the model must be kept compact enough to ensure that the efforts and time needed for calibrating the model parameters is not too extreme (Tarvid, 2016).

One more limitation is that ABMs are rarely comparable. ABMs are often built for a specific dataset with a certain purpose and theoretical content. There is no commonly accepted approach to evaluate the effectiveness of different modelling approaches (Janssen, Alessa, Barton, Bergin & Lee, 2008). This makes it difficult to assess how well models developed for one application function when applied to another dataset. It is also difficult to compare the outputs of different models of the same phenomenon.



### 3. Methodology

#### 3.1 Research approach

The research process that is followed to reach the research aim can be appropriated along three main research phases and ten research steps (figure 1). The first research phase is the theory phase in which literature is used to specify the theoretical approach and assumptions, and to identify the local government policy strategies and actions. After the completion of this phase, the first research question can be answered. The second research phase is the model set up, which focuses on the development of the ABM of this research. The first step in this phase is defining the agents, agent attributes, agent behaviours and agent interactions according to literature and survey data. This partly answers the second research question. After defining the model environment in the next step, the second research question can be answered fully. Then, the model is developed based on the answers to the first and second research question. The last step in the model set up phase is defining the scenarios. The last research phase is the analysis phase in which the model is run and the scenario-based analysis is performed. The completion of these two steps provides an answer to the third research question. The discussion and conclusion are the last two steps.

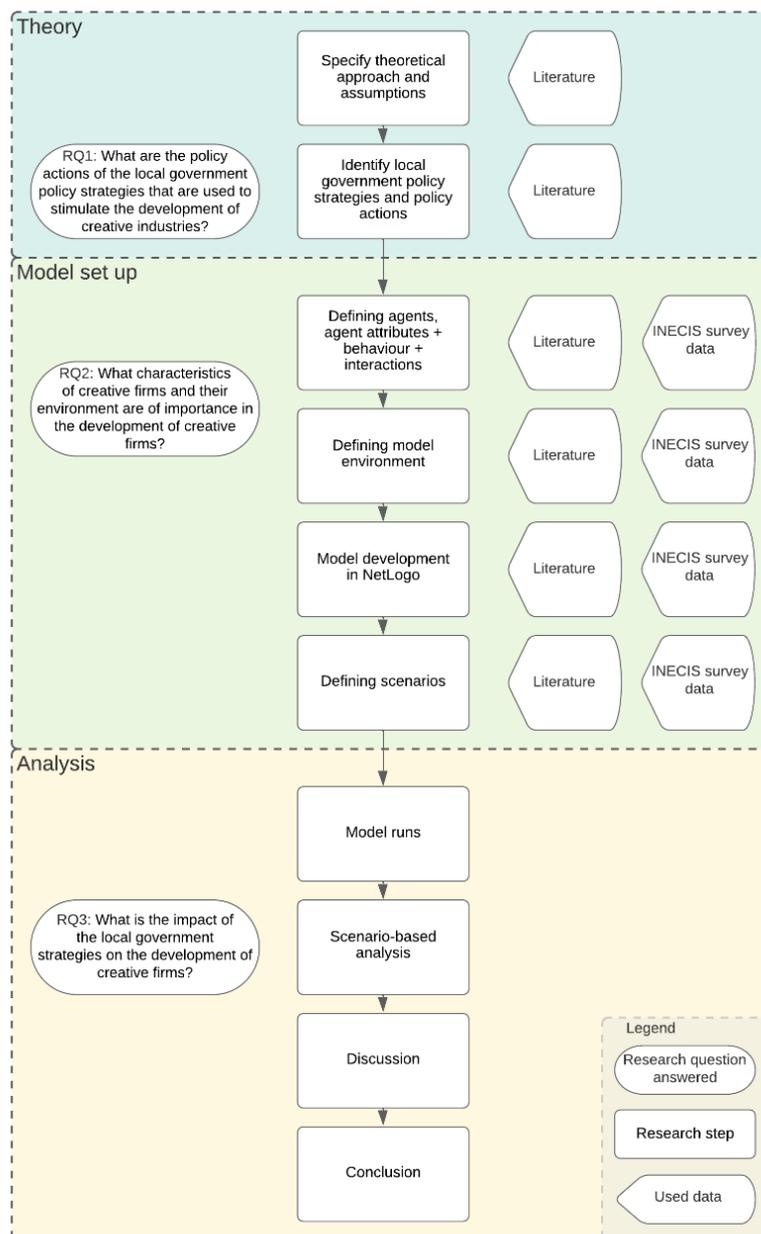


Figure 1: Research approach



### 3.2 Case study areas

To answer the research question, three kampungs (neighbourhoods) located in Bandung have been selected as the case study areas of this research. Bandung is the third-largest city in Indonesia and the capital of West-Java. Bandung is branded as a creative city (Chan & Raharja, 2018) and has gained local, regional, national, and international recognition due to the creative activities that are hosted. In addition, Bandung has been recognised as one of the regions that contributes the most to the exports from West-Java that come from creative industry sectors (Perbendaharaan, 2018). This makes Bandung a suitable area to focus on in this research. In Bandung, there are many kampungs that host creative industries and activities. Three kampungs are selected as case study areas, which are Binong Jati, Cigadung and Dago Pojok (figure 2). The main creative activities of these kampungs are respectively batik production, performance/fine arts and handicrafts, and knitted clothing (Madureira, Bustamante Duarte, Pfeffer, Fahmi, Nurman & Aritenang, 2021).

The administrative borders of the subdistricts in which the three kampungs are located are used in this research. The borders of kampung Binong Jati match the borders of subdistrict Binong. However, the physical borders of kampung Cigadung and kampung Dago Pojok in their subdistricts are unclear, not documented in a precise way, and thus not available to use. The administrative boundaries of the subdistricts are suitable to use as these are the closest to the borders of the kampungs.

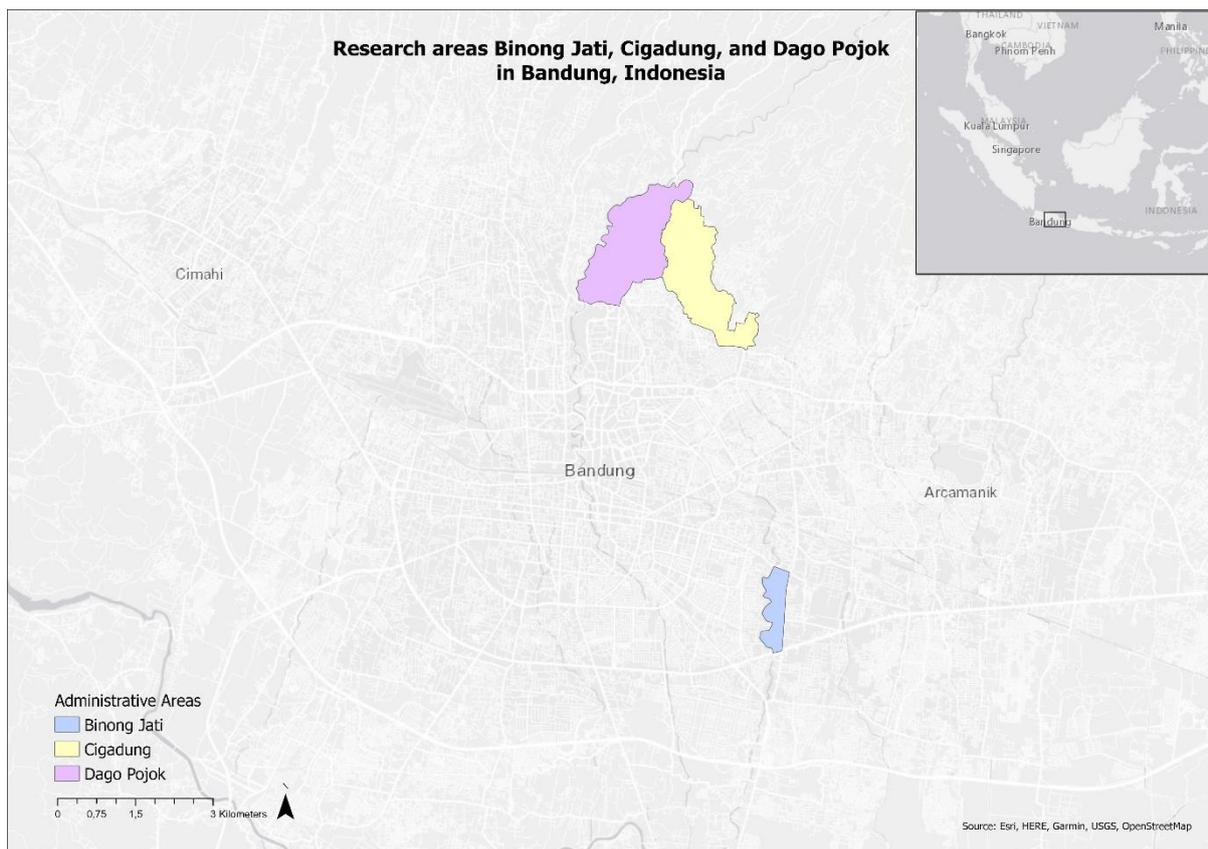


Figure 2: Locations of the three kampungs selected as case study areas

### 3.3 The model

A series of steps are taken to design and build the ABM. These steps are based on the steps suggested by Macal & North (2010) and Abdou, Hamill & Gilbert (2012) and are the following:

1. Identify the research question(s)
2. Specify theoretical approach and assumptions
3. Identify the agents
4. Define agent attributes
5. Define the model environment
6. Define agent behaviours/interactions
7. Set up the model
8. Set up methods for model verification and validation



9. Define the scenarios
10. Run the model for each scenario

### **3.3.1 Model purpose (step 1 and 2)**

The research aim and research questions of this research are identified in paragraph 1.2 and 1.3. The research aim and questions were used to specify the theoretical approach and assumptions which are described in chapter 2. The purpose of the ABM is set up according to these two steps, as it is used to fulfil the research aim. The main purpose of the ABM is to understand to what extent the local government strategies impact the development of creative industries in the three case study areas (Binong Jati, Cidagung and Dago Pojok). These impacts can then be assessed, which makes it possible to fulfil the research aim.

### **3.3.2 Agents (step 3)**

Based on the theoretical framework and the INECIS survey, three agent types are identified: external suppliers, external customers, and creative industry firms. External suppliers sell products to creative firms. External is used to indicate that this type of suppliers does not include creative firms that sell their products. The external suppliers look for a location with sufficient accessibility in the kampung and thus try to locate near the road network.

External customers buy products from the creative firms. Just as for the external suppliers, external is used to indicate that this type of customers does not include creative firms that buy products. The external customers also look for a location to settle. They want to locate near creative firms that have their customer type as a customer target. Their location choice is thus determined by the presence of creative firms and the distance to the road network.

Creative industry firms buy products from suppliers, sell products to customers and are looking for a place to settle in the kampung. They can buy products from external suppliers or other creative firms, and they can sell products to external customers or other creative firms. This means that creative firms can behave as well as a supplier or customer. A creative firm behaves as a supplier if it sells products to another creative firm and behaves as a customer if it buys products from another creative firm, in both situations thus from the same agent type. Finally, the newly created creative firms try to find the best location to settle based on four factors. The results from the INECIS survey show that closeness to suppliers, closeness to customers and closeness to similar businesses are three of the most mentioned advantages of a creative firm's location (table 6, table 7, table 8, appendix 1). Their proximity thus also influences the location choice of creative industry firms. In addition, accessibility is of importance. Creative firms also consider the closeness to the road network to ensure that the location also has a good accessibility.

### **3.3.3 Agent attributes (step 4)**

The agent attributes are based on the theoretical framework and the INECIS survey. The attributes of the creative industry firms are customer target, supplier list, customer list, number of customers, location, main product, number of employees, and supply (table 2). The number of employees is included to get results on both smaller and larger creative firms in terms of employees. Four categories in firm size have been determined according to the *Badan Pusat Statistik (BPS)* which is the Indonesian Central Bureau of Statistics (2016). They use an employment-based definition in which micro firms employ 1-4 people, small firms employ 5-19 people, medium firms employ 20-99 people, and large firms employ above 100 people. Supply indicates if the creative firm can supply to other creative firms. The INECIS survey and literature show that creative firms often buy and/or supply to other creative firms.

The attributes of the external suppliers are location, main product, and creative firms list (table 2). The main product of suppliers indicates which product it supplies. This determines which creative firms potentially chooses this supplier to buy their supplies from.

The attributes of the customers are location, creative firm list, and the type of customer (table 2). The type of customer is included to find out if the policy actions have a different impact on creative industry firms with different type of customers. This could mean that the local government should take the type of customer into account when making the policy strategies and deciding on policy actions.



Table 2: Agents and attributes of the ABM

Agent	Attribute	Value	Determined how + weights	Static or dynamic
Creative industry firm	Customer target	One of: Individual customers Other Tourists Government institutions Firms	Weights based on INECIS survey: 0.1 0.5 0.1 0.1 0.6	Static
	My suppliers	List of suppliers	All suppliers with the main product of the firm	Dynamic
	My customers	List of customers	All customers that are the customer target of the firm	Dynamic
	My customer count	Number of customers within a radius of twenty	Calculating the number of customers within a radius of twenty	Dynamic
	Location	Patch coordinates (X, Y)	Location choice formula	Static
	Main product	One of: Batik Performance/fine arts Handicrafts Knitted clothing	Weights based on INECIS survey: 0.1 0.1 0.1 0.8	Static
	Number of employees	One of: Micro: 1-4 employees Small: 5-19 employees Medium: 20-99 employees Large: 100+ employees	Weights based on INECIS survey and BPS: BJ: 0.22 C: 0.20 DP: 1.00 0.59 0.70 0.00 0.17 0.00 0.00 0.02 0.10 0.00	Dynamic
	Supply	One of: True False	Weights based on INECIS survey: 0.7 0.3	Static
External suppliers	Location	Patch coordinates (X, Y)	Random	Static
	Main product	One of: Batik Performance/fine arts Handicrafts Knitted clothing	Weights based on INECIS survey: 0.1 0.1 0.1 0.8	Static
	My creative firms	List of creative firms	All creative firms that have the main product of the supplier	Dynamic
External customers	Location	Patch coordinates (X, Y)	In radius of fifteen of a creative firm that has the customer target of the customer	Static
	My creative firms	List of creative firms	All creative firms that have the customer target of the customer	Dynamic
	Type of customer	One of: Individual customers Other Tourists Government institutions	Weights based on INECIS survey: 0.1 0.5 0.1 0.1	Static
	Scenario	One of: None Tourist information centre Innovation development facility	1 in baseline, 0.5 in other scenarios 0.2 in tourism development scenario 0.2 in industrial centres development scenario	Static



### **3.3.4 Model environment (step 5)**

For each of the three case study areas, the model environment is set up. The model environment consists of the administrative borders as depicted in figure 3. The road network is also included in the model environment. This includes the roads inside the kampungs, but also the roads that are near the borders of the kampungs. This way, locations near the kampung borders that are far from the roads in the kampung, but close to the roads outside of the kampung are seen as a feasible option in terms of accessibility to the road network.

### **3.3.5 Interactions (step 6)**

The conceptual model of the ABM combines the agents, agent attributes, model environment and agent interactions from step 3 to 6 (figure 3). The model input consists of the scenarios that are set up based on the local government policies and policy actions. These are translated into the model environment. The model environment consists of the environment characteristics and the agents with their attributes. A creative industry firm has three types of agent interactions (black arrows). It interacts with suppliers as the firm buys products from the supplier, and the supplier provides these products. A creative industry firm also interacts with customers as they sell products to the customers and customers buy from creative industry firms. The third interaction is with other creative industry firms when they buy from or sell to the creative firm. This is represented by the arrow that points from the creative industry firm to itself. The agent attributes and the relationships between them are shown in the conceptual model with the green arrows. These are explained in more detail later in this paragraph.

The model environment consists of the three kampungs and the road network in the kampungs. All agents interact with this attribute as this attribute influences their location choice. The suppliers and customers find a location in the kampungs and close to the road network. The creative firms take the proximity to the road network into account in their location decision process.

The behaviours and interactions as described above determine if a creative firm can find a suitable location and eventually if the creative firm is able to survive in the model. If this is not the case, the creative firm goes bankrupt. This in turn determines the model output, which consists of the spatial patterns that originate from the location choices of the creative firms. These patterns are analysed to see if clustering of creative industry firms is present and, if this is the case, if the firms cluster based on a certain attribute/characteristic. Another output that is analysed is the number of creative firms that go bankrupt in the model.

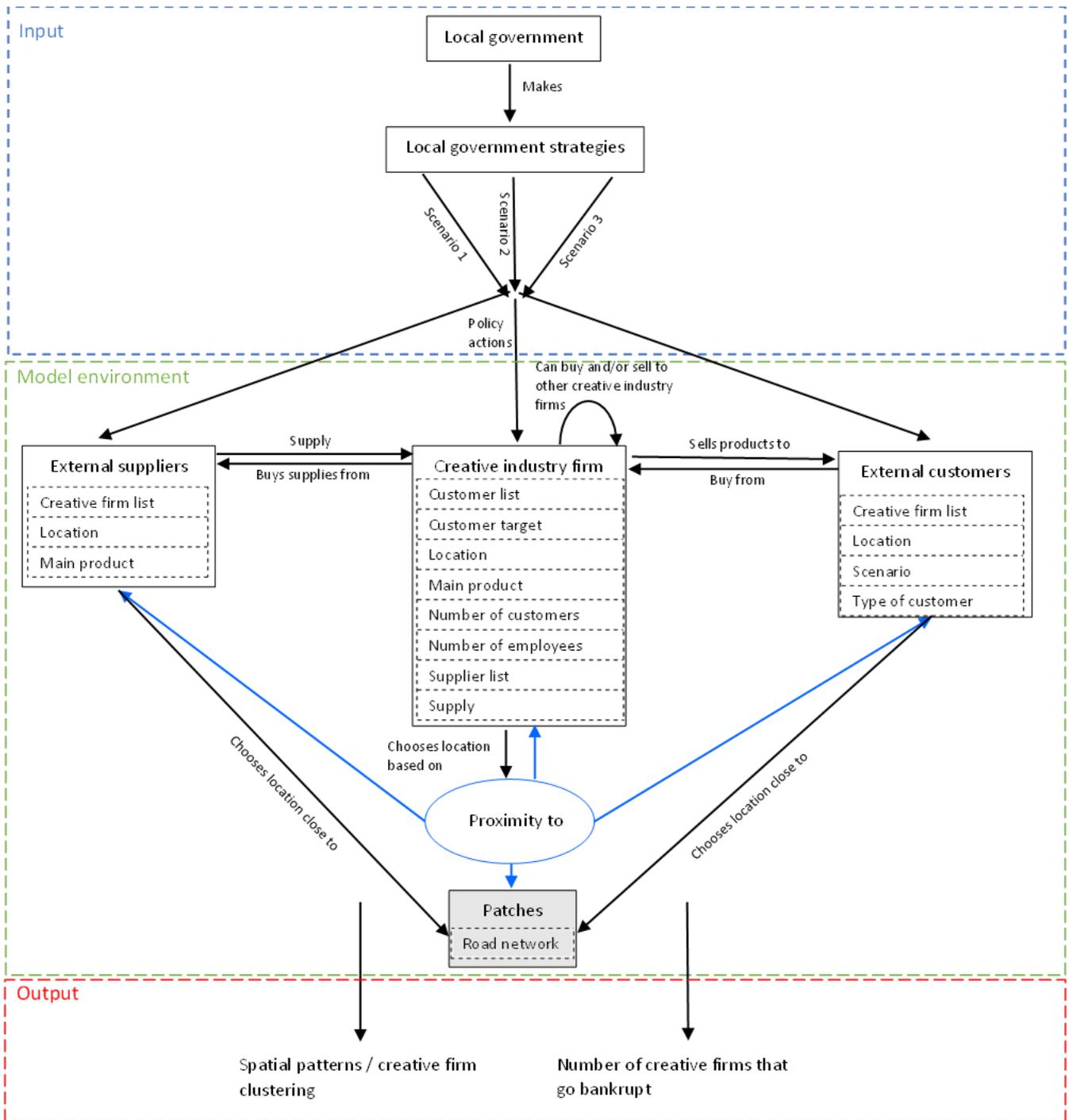


Figure 3: Conceptual model of the ABM



Figure 4 shows the attribute relationships of the agents in more detail. A creative firm chooses a supplier based on the main product of the supplier. This is the case as the creative firms want to buy supplies that contribute to the production of the main product of the firm. The product the supplier offers thus needs to match the main product of the creative firm. The customer choice is similar to the supplier choice. Both choices are also determined by the supply behaviour of the creative firms. If a creative firm behaves as a supplier, its customer choice can be other creative firms which is not possible if a creative firm does not behave as a supplier. The number of customers that a creative firm has is calculated by counting the number of customers that match the creative firms' customer target within close proximity. The number of employees increases if a creative firm has four or more customers in close proximity. The survey data showed that whenever a creative firm had an increase in the number of sales, the number of employees increased as well. This increase in number of sales is related to the number of customers as more customers indicates more sales.

The location choice of the suppliers, customers, and the creative firms are all partly determined by the road network. For the creative firms, their location choice is also determined by the customer choice, the customer location, the supplier choice, and the supplier location. They take the proximity to the suppliers and customers into account. The supplier choice and customer choice determine of which suppliers and customers they need to check the proximity. The presence of similar firms determines the location of the creative firm as well. These interactions are based on the INECIS survey results.

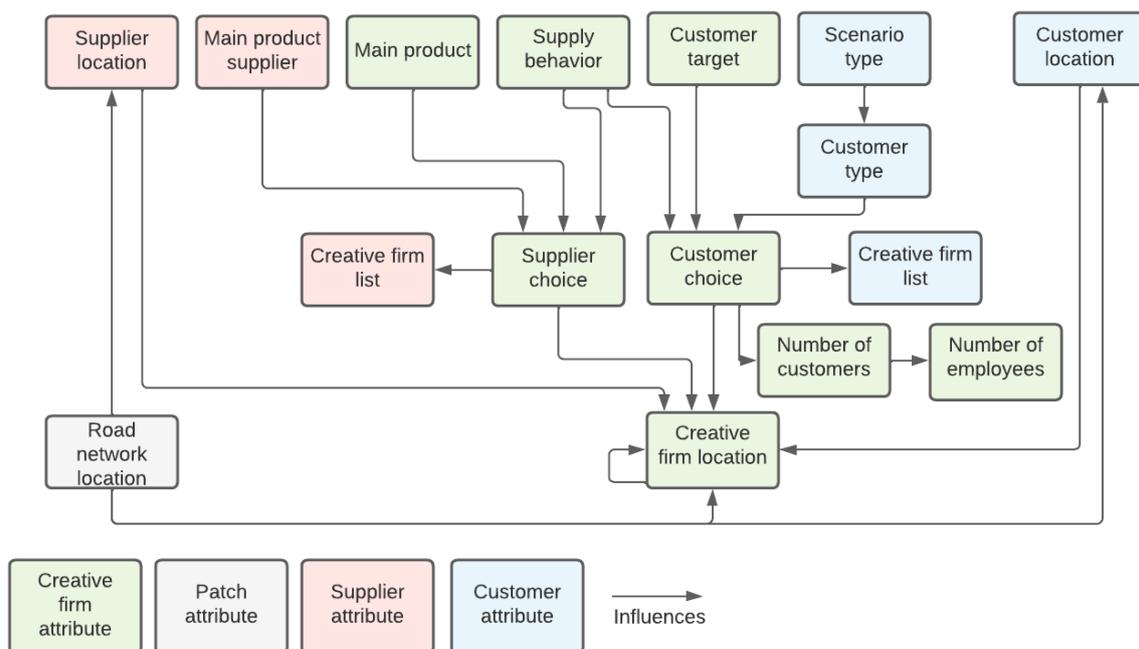


Figure 4: Detailed diagram of the attribute relationships

### 3.3.6 Setting up the model (step 7)

The completion of the previous steps results in a model design that contains the specified agents and environment. This model design is implemented. According to Abdou et al. (2012), two main procedures are included in the model implementation. The first procedure is the setup procedure. This procedure initialises the simulation. It specifies the initial conditions of the model and is done once at the beginning. This part of the program loads the data, makes the environment (which of the three kampungs), and specifies the initial attributes of the agents. The initial conditions are set based on the INECIS survey data for each kampung (table 3). The locations of the creative firms are based on the locations of the respondents of the INECIS survey. The initial suppliers and customers are in close proximity to the initial creative firms. The timestep conditions are also set up. A timestep is a measure of time in the model. Timesteps are used instead of seconds, minutes, or hours as timesteps are standardised across all models and computers. In this ABM, a timestep represents one

Table 3: Initial agents

Kampung	Initial creative firms	Initial suppliers	Initial customers
Binong Jati	104	40	130
Cigadung	10	7	13
Dago Pojok	8	5	10



year. Each timestep, ten new creative firms are created, because, on average, the INECIS survey has ten respondents for each year from 2014 to 2018.

The second procedure is the dynamics procedure. This procedure is repeatedly executed for each timestep to run the simulation (hereafter referred to as the GO-procedure). It asks agents to interact with the environment and other agents, according to their behavioural rules (Abdou et al., 2012). Figure 6 presents the GO-procedure of the model. In each timestep, the same steps are taken. A creative firm is created, after which the attributes are set, and its suppliers and customers are chosen. Based on these three steps, the creative firm calculates the best location using the location choice formula and locates there (equation 1).

$$(supplierquality * meanweightdistancetosupplier) + (customerquality * meanweightdistancetocustomer) + (similarquality * meanweightdistancetosimilarfirms) + (roadsquality * meanweightdistancetoroads)$$

Equation 1: Location choice formula

The location choice consists of four factors: supplier-quality, customer-quality, similar-quality, and roads-quality. The supplier-quality is determined by calculating the distance to the nearest supplier that can supply the creative firm. The customer-quality is determined by the number of customers in close proximity to the potential location. The roads-quality is determined by calculating the distance to the nearest road. The similar-quality is determined by the number of similar creative firms in close proximity to the potential location. Based on the INECIS survey, weights are assigned to each factor (table 4). This location choice formula is applied on fifteen random locations in the kampung for each creative firm, instead of on every possible location in the kampung. This is based on the methods of Brown & Robinson (2006), to account for space availability in the real-world as not all places in the kampung are available at each point in time for a creative firm to locate on.

Table 4: Location factor weights

Factor	Weight
Supplier-quality	46%
Similar-quality	29%
Customer-quality	15%
Roads-quality	10%

After the creative firm made its location choice, the model checks if there has been an increase of ten creative firms. If this is the case, new suppliers and customers are created. The number of suppliers is set to be  $\frac{1}{3}$  of the number of creative firms. The number of customers is set to be  $\frac{1}{4}$  more than the number of creative firms. This means that each timestep, the model calculates if there are enough suppliers and customers and adds new suppliers and customers if this is not the case. After that, the model checks if twenty timesteps have passed in the model. If this is the case, the model determines which creative firms go bankrupt and then stops. The bankrupt creative firms are determined by checking each creative firm on its number of customers in close proximity and number of employees. The number of customers must be larger than two and the number of employees must be larger than zero for a creative firm to survive. This is based on the data from the INECIS survey in which most firms have at least two customers and at least one employee. This means for example that if a customer has eight employees, but only one customer in close proximity, the creative firm goes bankrupt. The bankrupt creative firms are checked at the end of the model run and not during the model run. This is done as there is a lack of information on how long creative firms can exist without customers and/or employees. If less than twenty timesteps have passed, the GO-procedure is repeated. As each model timestep represents one year, the model is set to stop after twenty years. The initial state of the model represents 2014, which means that the model is set to stop in 2034. Twenty years is based on the length of the policies. The Bandung Tourism Development Master Plan is planned to run from 2012 to 2025, the Bandung Spatial Plan from 2011 to 2031 and the Bandung City Industrial Development Master Plan from 2019 to 2039. This indicates that the policy goals should be possible to achieve in twenty years.

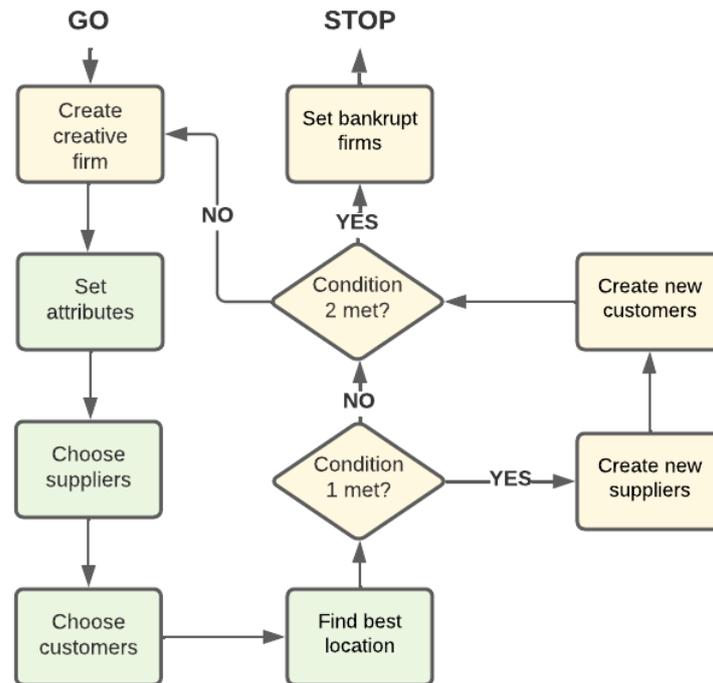


Figure 5: GO-procedure. Yellow boxes represent actions performed by the model and the green boxes represent steps taken by the creative firm agent.

### 3.3.7 Set up methods for model verification and validation (step 8)

The model set up is an iterative process which is led by verification (North & Macal, 2007). Verification concerns whether the model is working as expected (Klügl, 2008) and is performed as indicated in figure 7. Setting up the model is divided in small steps. In each step, the model is checked every time a change is implemented, or a new feature is added. This 'check' determines if the implemented change or feature works as it should. If this is the case, a new feature is added. If this is not the case, the changes are revised and adapted after which the model is revised again to see if it works. This is done repeatedly until the change or feature works as expected. When the model is considered done, outputs are generated. These outputs are then verified as well.

The model verification is followed by the model validation. The aim of the validation is to assess the plausibility of the outputs of the model (Klügl, 2008). There is empirical and statistical data related to this thesis subject available. The INECIS survey provides this data. Its results contain data on the locations of the creative firms that originated between 2014 and 2018. As the initial model set up is based on data from 2014, it is possible to validate the outputs until 2018. Fifteen validation runs are conducted, for four timesteps each (thus four years). The outputs of the validation runs are compared to the data from 2018 to check to what extent the results are similar. Analysing the model outputs is done after the verification and validation.

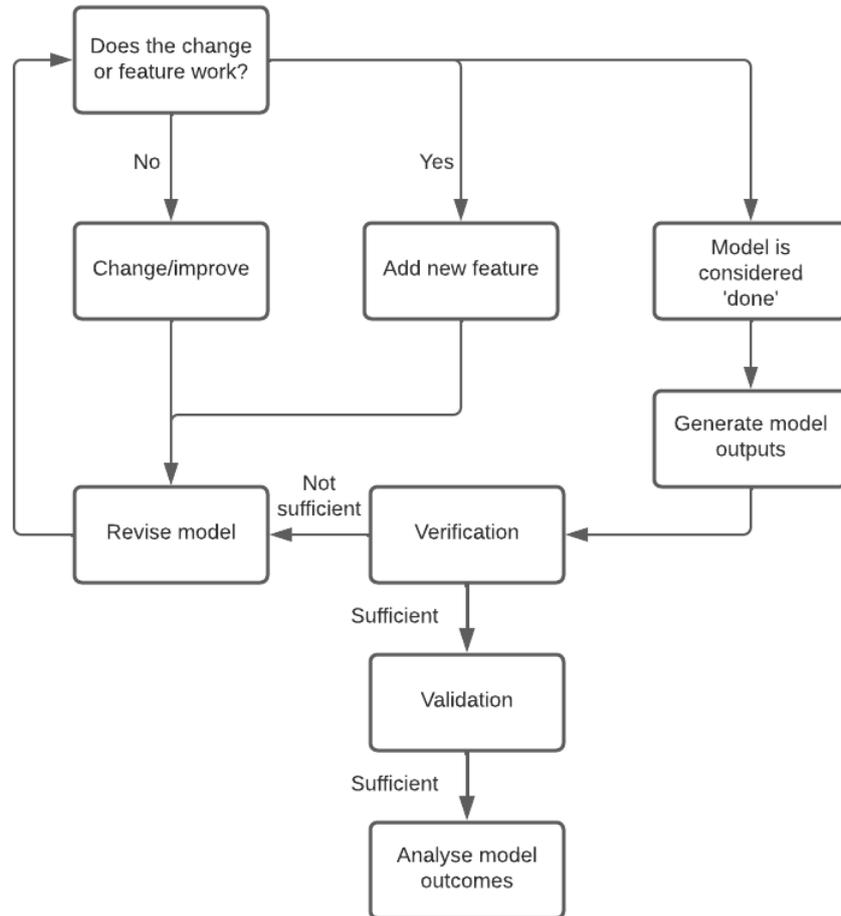


Figure 6: Iterative process of the model set up

### 3.3.8 Scenarios and model run (step 9 and 10)

The Bandung Spatial Plan 2011-2031, the Bandung mid-term development plan 2013-2018/2018-2023, the Bandung Tourism Development Master Plan 2012-2025, and the Bandung City Industrial Development Master Plan 2019-2039 have been reviewed in paragraph 2.4. They are reviewed as these are the main spatial plans of Bandung and are also considered the main development strategies targeting the development of creative industries (Fahmi et al., 2017). Next to the policy plans, information about the implementation of these policy plans is used. How these policies have been implemented and which measures were used determine what is used as input for the ABM and are therefore the basis of the scenarios (table 5).

The first defined scenario is the baseline scenario, which is also known as the reference, benchmark, or non-intervention scenario (European Environment Agency, 2021). This scenario depicts the future in which no new policies are implemented apart from the policies that are already applied in the real world. The outputs of the other scenarios are compared to those of the baseline scenario. This is done to find out if there are differences, and if yes, what these differences are.

The other scenarios are set up based on the local government strategies in Bandung that have been discussed in section 2.4. The aims of these strategies can be categorised in three main themes. The first is maintaining economic growth, the second is the development of industrial centres, creative industry clusters and small and medium industries, and the third is tourism development. The second and third theme are the most extensive and have a clear description of the policy strategies and policy actions and are thus suitable to translate into scenarios for the ABM.

The second defined scenario is the industrial centres development scenario. As the scenario name implies, this scenario is focused on the development of industrial centres. Four policy actions are selected to be included in the scenario. The first policy action is offering financing to creative firms. The aim of financing is to ensure that more creative firms can start up. This is translated in the model by changing increasing the number of created firms per time step to fifteen, which is an increase of 50%. The second policy action is offering training/workshops/assistance programs to creative firms. This policy actions focuses on micro and small firms. This is translated into the ABM by changing the input



distribution of the creative firms. The chances of a creative firm to be a micro or small firms is 20% higher in the new distribution. The third included policy action is the development of innovation development facilities/creativity facilities/small industry service centres that support creative industry activities. In the model, innovation development facilities are created that offer assistance to micro and small firms. The chances of a micro and small creative firm to go bankrupt is decreased by 75% if there is an innovation development facility in close proximity. The fourth and last policy action is increasing the quantity and quality of the city's infrastructure. To do so, modifications are made in the road network in the kampungs.

The third defined scenario is the tourism development scenario. Two policy actions are selected to be included in the scenario. The first included policy action is increasing tourism in creative kampungs by establishing information centres and co-working spaces and by managing creative tourism programmes. This is translated in the model by placing tourist information centres in the kampung, which attract tourist customers. The second included policy action is hosting festivals/contests in the kampung. This is translated into the model by placing a festival in the kampung. As the aim of this policy action is to attract tourists, fifty tourists are placed in close proximity to the festival.

Table 5: Scenarios

Scenario	Description	Policy action	Adjusted parameters	Modifications
1 - Baseline	The initial model result	-	None	-
2 - Industrial centres development	An exploratory scenario in which selected policy actions for the development of creative industries are present	Increasing the quantities and developing the qualities of supporting infrastructures	Shapefile of the road network	Road network in the kampung extended by additional roads
		Improving financing access + provide financial subsidies, machines, and a financial assistance program	Number of added creative firms per timestep	Number of creative firms added per timestep multiplied by 1.5 (15 instead of 10)
			Input distribution of the firm size in terms of employees	The input firm distribution changes. When a new firm is created, the chance that it is a micro or small firm increases with 20%
		Offer technopreneurship training and workshops + workshop and advocacy for industrial employees, owners, and agency employees	Add innovation development facilities as customers	Innovation development facilities are placed in the kampung. Micro and small firms in close proximity to the innovation development facility gain an extra customer and an extra employee
3 – Tourism development	An exploratory scenario in which selected policy actions aimed at the development of tourism are present	Establish art festivals and knitting contests	Initial number of tourist customers	A festival is placed somewhere in the kampung, and 50 tourist customers are placed in close proximity to the festival/contest
		Developing creative tourism programmes at creative industry attraction	Number of added tourist customers per time step	Tourist information centres are placed in the kampung and attract tourist customers each timestep

The last step in building and designing the model, is to run the model  $x$  times per scenario. Agent-based modelling has a stochastic nature, which means that each run produces a different output (Abdou et al., 2012). It is therefore essential that more than one run is undertaken to systematically explore the output results (Van Dam, Nikolic & Lukszo, 2012). Monte-Carlo is used to quantify the output distribution. The Monte-Carlo analysis is a simulation technique in which a process is simulated many times, each time with different initial conditions. The result of this analysis gives a range of possible outcomes and probabilities (Mooney, 1997). The outcomes of the Monte-Carlo analysis in this research shows that fifteen model runs per scenario is enough to generate sufficient output results. After the model runs, the scenario analysis is performed.

### 3.4 Model output analysis

After the completion of the ten steps as described in the previous paragraph, the outputs of the model



runs are analysed per scenario to answer the third research question. Creative industry firms choose a location in the model runs, which causes spatial patterns in the kampungs. The spatial patterns of the creative firms are analysed to find out if clustering takes place and, if this is the case, where the clustering is based on. An average nearest neighbour analysis is used to analyse if clustering takes place. In this analysis, the distance between each creative firm and its nearest creative firm is measured. These distances are then averaged. The average distance is divided by the expected average distance to calculate the average nearest neighbour ratio (Esri, 2021). A ratio less than 1 indicates spatial clustering and a ratio greater than 1 indicates dispersion.

If this analysis shows that there is spatial clustering, it is checked where this clustering is based on. This is done using the Moran's I spatial autocorrelation analysis. This is a widely used spatial statistic technique that measures spatial autocorrelation (Li, Calder & Cressie, 2007). It tests if features which are located closer together are more likely to have similar attributes than those which are further apart (Moran, 1950). Three values are generated for each model run, which are the I-value, the Z-score, and the P-value. The I-value the Moran's I-statistic which results in a value from -1 to 1, in which -1 is perfect dispersion, 0 is perfect randomness, and 1 is perfect correlation (clustering) (Wang, Li, Myint, Zhao & Wentz, 2019). The Z-score is the number of standard deviations that a data point lies above or below the mean, and the P-value is the significance value. The Moran's I analysis is done for the following five attributes of the creative firms: main product, customer target, number of employees, number of customers, if the creative firm supplies to other firms or not.

Another output type that is analysed is the number of creative firms that went bankrupt. This is done by comparing the initial number of creative firms and the total number of creative firms that were created during the model run to the number of creative firms that went bankrupt. In addition, it is checked why the creative firms went bankrupt.

### 3.5 Data

OpenStreetMap data is used for the administrative borders of and the road networks in the kampungs. A raster dataset is made using the road network dataset from OpenStreetMap to calculate the distance to the road network. This raster dataset is used as input of the ABM.

Survey data is used to determine the agents' characteristics, attributes, and interactions. During the first year of the INECIS project as mentioned in paragraph 2.5, socio-spatial data was collected through a survey and interviews were conducted with community leaders in the kampungs. This data is used in this research. The INECIS' survey was conducted among owners/managers of creative firms in the three kampungs in Bandung that form the case study of this research (Binong Jati, Cidagung and Dago Pojok). The survey contains questions on six topics: socio-demographic and land use data, business characterization, business-related networks, networks and governance, business status, and policy awareness. The responses of this survey provide information about the attributes of creative firms in Bandung and in the three case study kampungs specifically. In total, 166 surveys were conducted between October 2019 and November 2019.

The INECIS data is currently private as it contains personal data. However, the open version will be available soon in the DANS repository with the following DOI: 10.17026/dans-z6s-47js. Because the data is still private, detailed information regarding the distributions and values from the INECIS survey cannot be shared in this thesis. The data (excluding the INECIS survey results) can be found in the .zip file that accompanies this thesis report (appendix 4).

### 3.6 Software

The software used in this thesis to set up and run the ABM is NetLogo. NetLogo is an agent-based modelling software package that is free for download (NetLogo, 2021). The NetLogo code of the ABM from this thesis as of March 4th, 2022, can be found in the [GitHub repository](#) and the .zip file of this thesis.

### 3.7 Scope and limitations

Several local government strategies and its policy actions are used in this research. By doing this, other factors that are of influence on creative industries are excluded from the analysis. For example, Martinaityte and Kregzdaite (2015) mention the GDP growth, personal income rate, unemployment rate, interest rate, price indexes, and subsidies from the state as other factors that are of influence on creative industries. From these factors, only subsidies from the state are considered as this factor is mentioned in the local government policies. The other factors are not mentioned in the government strategies as policy actions and are therefore not assessed in this research.



This research focuses on the implementation of policy actions. The included policy actions are chosen based on their relevance as there are different types of policy goals. Thus, the results of this research are focused on specific aspects of the local government strategies, instead of the strategies as a whole. In addition, this research does not focus on how policy strategies are set up or how policy actions are chosen.

A limitation in this research is that the result of this research shows to what extent these strategy aspects have an impact on the development of creative industries, not what this exact impact is. However, it is expected that the results show which policy goals are expected to be achieved with the current strategies.

Another limitation regards the method of determining the bankrupt creative firms. In the ABM, it is determined once which creative firms go bankrupt as there was a lack of information on how long creative firms can exist without customers and/or employees. This is done at the end of the model run, thus after 20 years. However, in the real-world, firms can go bankrupt after a shorter amount of time.

One more limitation is that the data used in the research is collected in 2019. This means that the research does not take the influence of the Covid-19 pandemic on the creative industries into account.



## 4. Results and discussion

### 4.1 Validation results

The initial number of creative firms is 104 in Binong Jati, 10 in Cigadung and 8 in Dago Pojok (table 9, appendix 2). In the validation runs, the number of creative firms in Binong Jati increased from 104 to 116 (12%) between 2014 and 2018, whereas this number increased from 104 to 129 (24%) in the validation data. In Cigadung, the number of creative firms increased from 10 to 31 (210%) in the model data and from 10 to 20 (100%) in the validation data. In Dago Pojok, the number of creative firms increased from 8 to 32 (300%) in the model data and from 8 to 12 (50%) in the validation data. The result from the validation runs thus show a difference of 10% (13 creative firms less) in Binong Jati, 55% (11 creative firms more) in Cigadung and 167% (20 creative firms more) in Dago Pojok, compared to the validation data (figure 7).

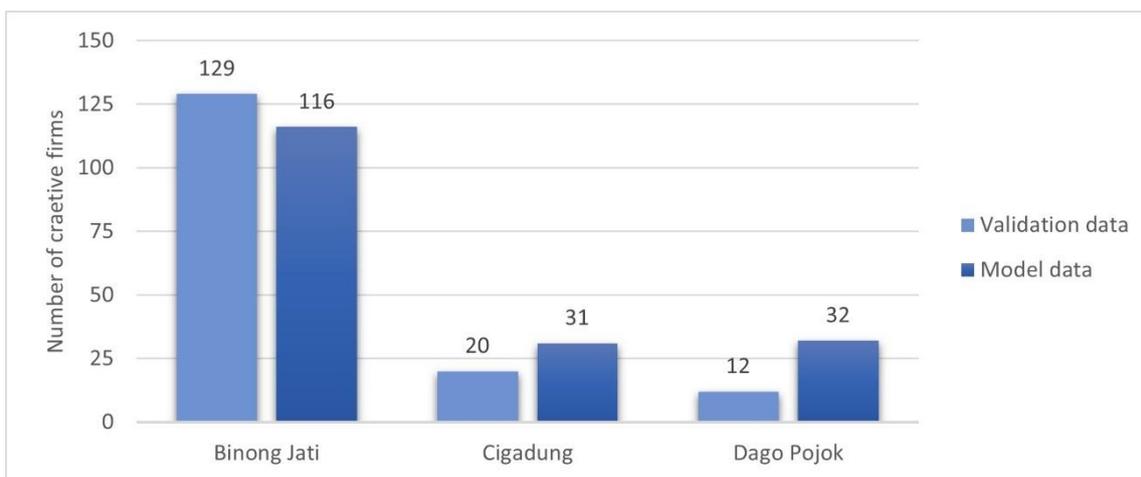


Figure 7: Bar chart of the number of creative firms in 2018 from the validation data compared to the model data

Most of the newly created creative firms in Binong Jati are located in the North of the kampung (figure 18, appendix 2, right map). The firms from the validation data are also mostly located in the North of the kampung (figure 18, appendix 2, left map). In Cigadung, the newly created firms are mostly located in the middle of the kampung (figure 19, appendix 2, right map). The firms from the validation data are not located in one particular area of the kampung. They are spread throughout the kampung instead (figure 19, appendix 2, left map). In Dago Pojok, most of the newly created firms are in the centre of the kampung (figure 20, appendix 2, right map). The creative firms from the validation data are also located in the centre of the kampung (figure 20, appendix 2, left map). The spatial patterns from the validation results and the validation data thus shows similarities in Binong Jati and Dago Pojok, and differences in Cigadung. The overall spatial patterns of the model outputs are thus deemed plausible. The exact locations of the newly created creative firms are different to the locations of the firms from the validation data. This is due to the stochastic nature of the model and does not diminish the quality of the model outputs.

To summarise, the validation results show differences in the exact number of the creative firms that emerge in the kampungs. In addition, the validation results show similarities in the overall spatial patterns. The validation results also show similar results as the number of creative firms increases in all three kampungs, which is also the case in the validation data. The results are thus deemed plausible based on the validation process.

### 4.2 Scenario 1: Baseline scenario

#### 4.2.1 Results

Out of the 200 new creative firms plus the existing creative firms, the average number of surviving creative firms is 234 in Binong Jati, 164 in Cigadung and 161 in Dago Pojok (table 10, appendix 3). The average number of bankrupt creative firms is 70 (23%) in Binong Jati, 46 (22%) in Cigadung and 47 (23%) in Dago Pojok (figure 10). Around 1% of the average number of bankrupt creative firms went bankrupt because the firm had no employees and around 99% went bankrupt because there were not



enough customers near the firm.

The average nearest neighbour index is 0.65 in Binong Jati, 0.69 in Cigadung and 0.70 in Dago Pojok. The significance values from these indexes are lower than 0.01. Thus, it can be stated that with 99% confidence, there is positive spatial autocorrelation for the creative firms in the kampungs.

The average Moran's I on the main product is 0.19 in Binong Jati, 0.31 in Cigadung, and 0.31 in Dago Pojok (table 10, appendix 3). The significance values are all less than 0.05. It can be stated that with 95% confidence, there is low to medium spatial autocorrelation (clustering) of the creative firms based on their main product in the kampungs. Creative firms with a similar main product are often located in close proximity (figure 8). For example, above the centre of the kampung, creative firms that sell batik are in proximity to each other and South in the kampung, creative firms that sell knitted clothing are in close proximity.

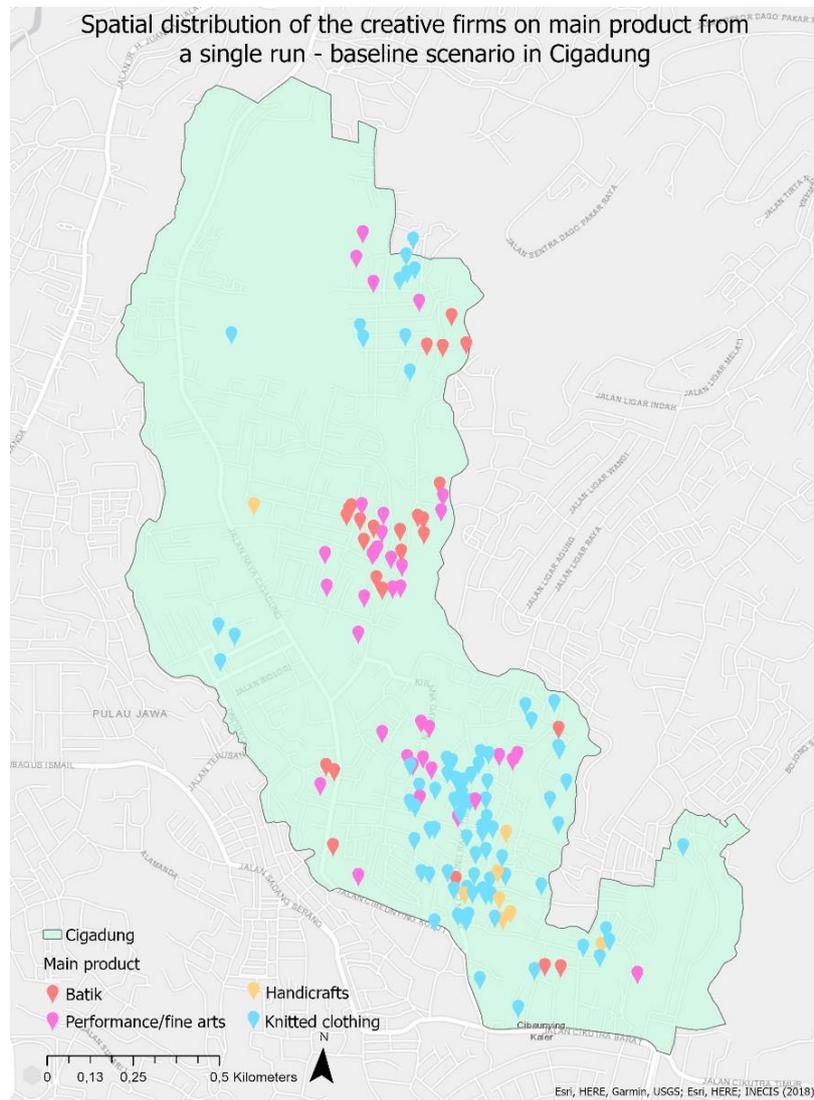


Figure 8: Map of the spatial distribution of the creative firms on main product from a single run from the baseline scenario in Cigadung

The results of the average Moran's I on the number of customers are statistically significant ( $p < 0.05$ ). The index values are 0.45 in Binong Jati, 0.36 in Cigadung and 0.48 in Dago Pojok. It can be stated that with 95% confidence, there is low to medium spatial autocorrelation (clustering) of the creative firms based on their number of customers in the kampungs.

The results of the average Moran's I on the customer target, the number of employees and if the creative firm supplies to other firms have a significance value greater than 0.05 (table 10, appendix 3). This means that the results are not statistically significant and thus do not give an indication on the clustering of creative firms on that attribute.



### 4.3 Scenario 2: Industrial centres development scenario

#### 4.3.1 Results

Out of the 300 new creative firms plus the existing creative firms, the average number of surviving creative firms is 329 in Binong Jati, 266 in Cigadung and 268 in Dago Pojok (table 11, appendix 3). The average number of bankrupt creative firms is 75 (19%) in Binong Jati, 44 (14%) in Cigadung and 40 (13%) in Dago Pojok. From the average number of bankrupt creative firms, around 1% of the creative firms went bankrupt because the firm had no employees and around 99% of the creative firms went bankrupt because there were not enough customers near the firm.

The average nearest neighbour index is 0.65 in Binong Jati, 0.66 in Cigadung and 0.67 in Dago Pojok. The significance values from these indexes are lower than 0.01. Thus, it can be stated that with 99% confidence, there is positive spatial autocorrelation for the creative firms in the kampungs.

The average Moran's I on the main product is 0.21 in Binong Jati, 0.28 in Cigadung, and 0.28 in Dago Pojok, all with a significance value less than 0.05. It can be stated that with 95% confidence, there is low to medium spatial autocorrelation (clustering) of the creative firms based on their main product in the kampungs.

The average Moran's I on the number of customers shows statistically significant results ( $p < 0.05$ ). The index values are 0.44 in Binong Jati, 0.36 in Cigadung and 0.48 in Dago Pojok. It can be stated that with 95% confidence, there is low to medium spatial autocorrelation (clustering) of the creative firms based on their number of customers in the kampungs.

The results of the average Moran's I on the customer target, the number of employees and if the creative firm supplies to other firms have a significance value greater than 0.05 (table 11, appendix 3). This means that the results are not statistically significant and thus do not give an indication on the clustering of creative firms on that attribute.

#### 4.3.2 Comparison baseline scenario

The average percentage of bankrupt creative firms in Binong Jati decreases with 4%, from 23% in the baseline scenario to 19% in the industrial centres scenario. In Cigadung the average percentage decreases with 8%, from 22% to 14%, and in Dago Pojok the average percentage decreases with 10%, from 23% to 13% (figure 9). The causes for bankruptcy are the same in the baseline and industrial centres development scenario. Around 1% went bankrupt because there were not enough employees and around 99% went bankrupt because there were not enough customers in close proximity.

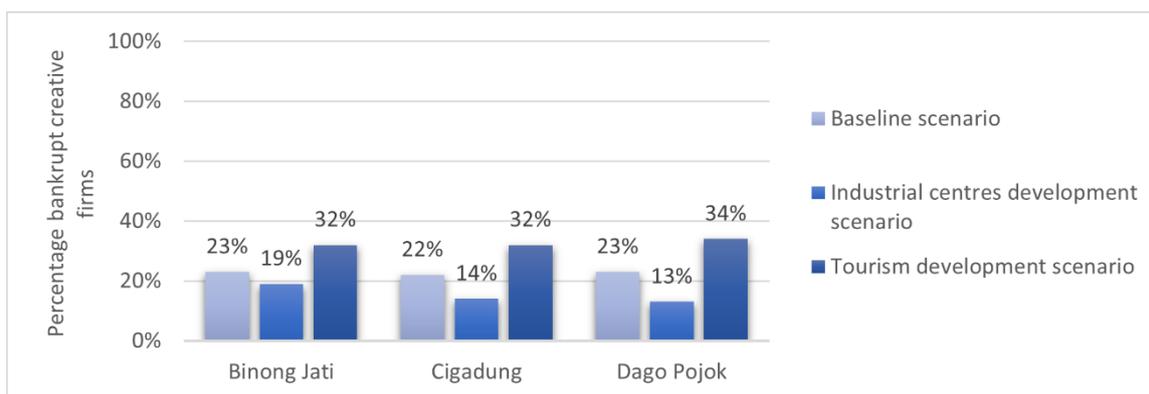


Figure 9: Bar chart of the average percentage of bankrupt creative firms per kampung for each scenario

The decrease in average percentage of bankrupt creative firms indicates that the policy actions from this scenario help creative firms in their start-up process and prevent several of them from going bankrupt. The decrease also implicates that, in line with the policy goals, the development of creative firms in terms of growth of the number of creative industry firms in Bandung increases.

A study by Menkshi & Brahल्ली (2019) includes the mapping and evaluation of sectors of the cultural and creative industries in Korça city, Albania. They state that the local government should increase subsidies to individuals and other organizations in the cultural and creative industries. The results show a decrease in the number of bankrupt creative firms. This indicates that offering financing positively affects the development of creative firms. The findings from the industrial centres development scenario thus support the statement by Menkshi & Brahल्ली.

Another one of these policy actions is the development of facilities/creativity facilities/small industry service centres that support creative industry activities of micro and small firms. The results



show that the innovation development facilities are distributed throughout the whole kampung and are in close proximity to the creative firms (figure 10). It is expected that the presence of these innovation development facilities makes it easier for creative firms to survive as they offer help to creative firms. This help includes attracting more customers and offering workshops and training to the employees of the firms to gain more skills.

A previous study by Raharja & Nurasa (2020) includes an analysis of the Bandung policy for developing creative industries. They recommend that the establishment of creative industries can be facilitated by providing technical guidance, training, and capital assistance and by creating business networks. The results from this research show that more creative firms survive when there is a provision of training and workshops in the kampungs. This shows that the establishment of creative industries can indeed be facilitated by providing training and workshops. The results of the industrial centres development scenario thus support the findings from Raharja & Nurasa (2020).

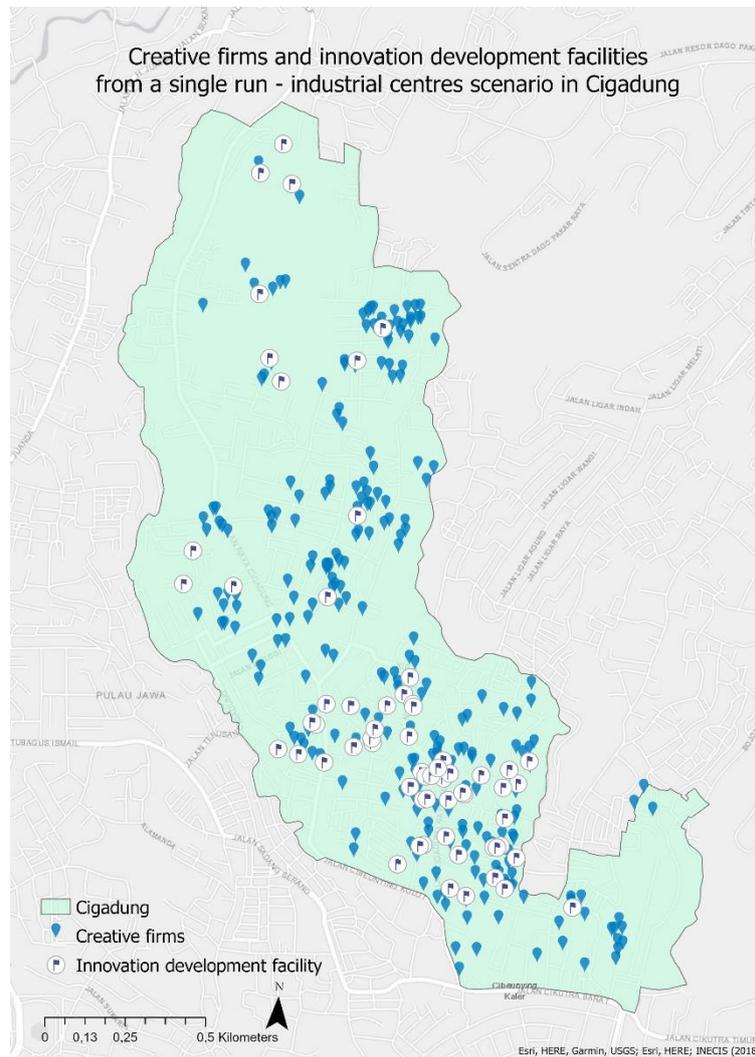


Figure 10: Map of the creative firms and innovation development facilities in Cigadung from a single run from the industrial centres scenario

The average nearest neighbour index in Binong Jati is 0.65 in both the baseline and the industrial centres development scenario (figure 11). In both Cigadung and Dago Pojok the average nearest neighbour index decreases with 0.03 to 0.66 and 0.67 respectively. This indicates that the implementation of the policy actions from the industrial centres development scenario causes a similar amount of clustering as to when no new policy actions are implemented.

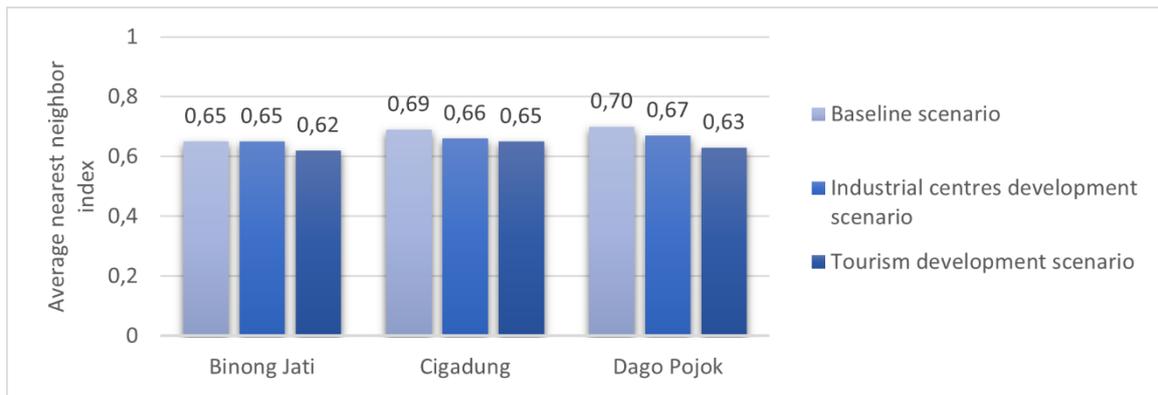


Figure 11: Bar chart of the average nearest neighbour index per kampung for each scenario

Compared to the baseline scenario, the average Moran's I on the main product of the creative firms increases with 0.02 in Binong Jati and decreases with 0.03 in both Cigadung and Dago Pojok in the industrial centres development scenario (figure 12). The average Moran's I on the customer target, the number of employees, if the creative firm supplies to other firms and the number of customers also show similar results for the two scenarios (table 10, table 11, appendix 3). The differences between the Moran's I values are small. The impact of the policy actions on the clustering patterns of the creative firms is thus limited.

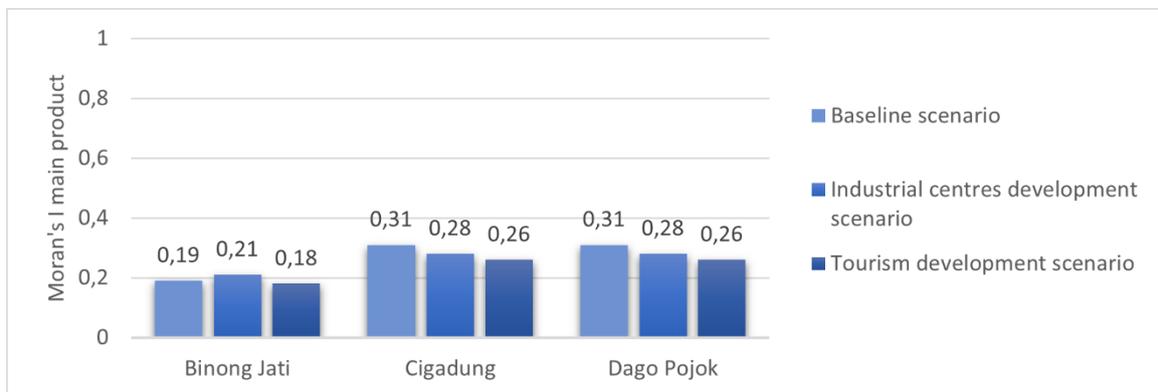


Figure 12: Bar chart of the average Moran's I on the main product attribute per kampung for each scenario

To summarise, it can be said that the improvement of financing access, the provision of financial subsidies and the offering of trainings and workshops cause a decrease in the number of creative firms that go bankrupt. These policy actions thus benefit both the creative firms and the local government. The creative firms benefit more from this as they get help and have a decreased chance of going bankrupt. The decrease also implicates that the development of creative firms in terms of growth of the number of creative industry firms in Bandung increases. The policy goals are thus achieved. The implementation of the policy action that involves increasing the quantities and qualities of supporting infrastructures does not cause a change in the spatial patterns of the creative firms. In addition, the implementation of the policy actions from this scenario does not cause changes in the clustering patterns, compared to the baseline scenario where no new policy actions are implemented.

#### 4.4 Scenario 3: Tourism development scenario

##### 4.4.1 Results

Out of the 200 new creative firms plus the existing creative firms, the average number of surviving creative firms is 208 in Binong Jati, 143 in Cigadung and 137 in Dago Pojok (table 12, appendix 3). The average number of bankrupt creative firms is 96 (32%) in Binong Jati, 67 (32%) in Cigadung and 71 (34%) in Dago Pojok. From the average number of bankrupt creative firms, around 1% of the creative firms went bankrupt because the firm had no employees and around 99% of the creative firms went bankrupt because there were not enough customers near the firm.

The average nearest neighbour index is 0.62 in Binong Jati, 0.65 in Cigadung and 0.63 in Dago Pojok. The significance values from these indexes are all lower than 0.01. Thus, it can be stated that with 99% confidence, there is positive spatial autocorrelation for the creative firms in the kampungs.



The average Moran's I on the main product is 0.18 in Binong Jati, 0.26 in Cigadung, and 0.26 in Dago Pojok. Each with a significance value less than 0.05. It can be stated that with 95% confidence, there is low to medium spatial autocorrelation (clustering) of the creative firms based on their main product in the kampungs.

The average Moran's I on the number of customers is 0.34 in Binong Jati, 0.22 in Cigadung and 0.39 in Dago Pojok (table 12, appendix 3). These results are all statistically significant ( $p < 0.05$ ). It can be stated that with 95% confidence, there is low to medium spatial autocorrelation (clustering) of the creative firms based on their number of customers in the kampungs.

The average Moran's I on the customer target is 0.12 in Binong Jati, 0.12 in Cigadung and 0.16 in Dago Pojok. The significance values of the Moran's I values are all lower than 0.05. It can be stated that with 95% confidence, there is low to medium spatial autocorrelation (clustering) of the creative firms based on their customer target in the kampungs.

The results of the average Moran's I on the customer target, the number of employees and if the creative firm supplies to other firms have a significance value greater than 0.05 (table 12, appendix 3). This means that the results are not statistically significant and thus do not give an indication on the clustering of creative firms on that attribute.

#### **4.4.2 Comparison baseline scenario**

The number of created creative firms in the tourism development scenario is 200, which is the same as in the baseline scenario. The average percentage of bankrupt creative firms in Binong Jati increases with 9%, from 23% in the baseline scenario to 32% in the industrial centres scenario. In Cigadung the average percentage increases with 10%, from 22% to 32%, and in Dago Pojok the average percentage increases with 9%, from 23% to 34% (figure 9). This indicates that the policy actions from the tourism development scenario cause more creative firms to go bankrupt than in the baseline scenario. This can be explained by the customer distributions in the tourism development scenario. The policy actions in this scenario are translated to more tourist customers. It is therefore expected that these policy actions help creative firms that have tourists as their customer target. However, the chances for a firm to have tourists as their customer target does not change. This means that the number of creative firms looking for tourists does not increase, while the number of tourists does increase.

The causes for bankruptcy are the same in the baseline and tourism development scenario. Around 1% went bankrupt because there were not enough employees and around 99% went bankrupt because there were not enough customers in close proximity.

The average nearest neighbour index from the tourism development scenario is 0.03 lower in Binong Jati, 0.04 lower in Cigadung and 0.07 lower in Dago Pojok (figure 11) than in the baseline scenario. This indicates that the implementation of the policy actions from the industrial centres development scenario causes a similar amount of clustering as to when no new policy actions are implemented.

Compared to the baseline scenario, the average Moran's I on the main product of the creative firms decreases with 0.01 in Binong Jati, with 0.05 in Cigadung and with 0.04 in Dago Pojok in the tourism development scenario (figure 12). The average Moran's I on the number of employees, if the creative firm supplies to other firms and the number of customers also show similar results for the two scenarios (table 10, table 12, appendix 3). This indicates that the policy actions do not have an impact on the clustering trends of the creative firms.

The average Moran's I on the customer target of the creative firms is higher in all three kampungs in the tourism development scenario compared to the baseline scenario. The values increase from 0.06 to 0.12 in Binong Jati, from 0.02 to 0.12 in Cigadung and from 0.05 to 0.16 in Dago Pojok (figure 13).

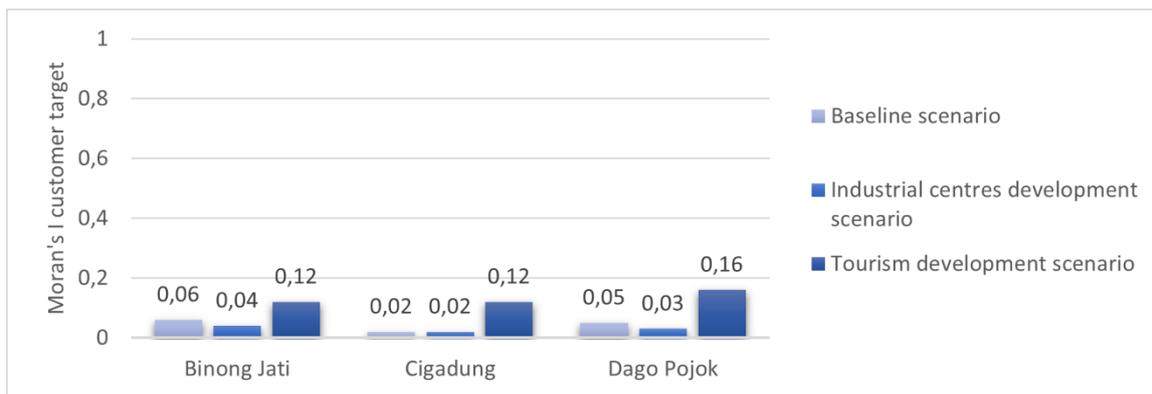


Figure 13: Bar chart of the average Moran's I on the customer target attribute per kampung for each scenario

This increase in the average Moran's I on the customer target attribute means that in the tourism development scenario, creative firms with a similar customer target locate near each other more than in the baseline scenario. For example, in the baseline scenario, creative firms with a different customer target (other, other firms, individual customers) are located near each other in the North of Binong Jati (figure 14, left map). In the tourism development scenario, firms with a similar customer target (other firms) are located near each other (figure 14, right map) in the North of Binong Jati.

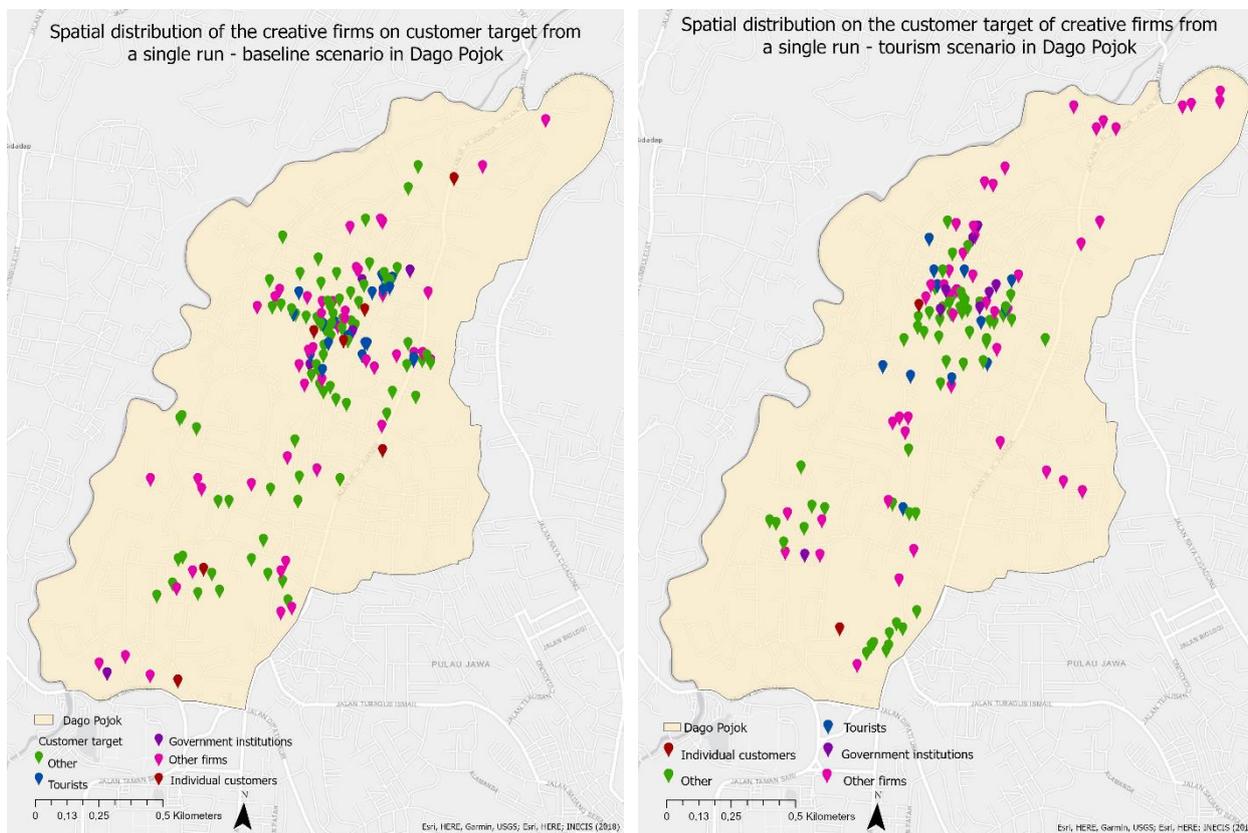


Figure 14: Map of the creative firms, customers, and suppliers in Dago Pojok from a single run from the baseline scenario (left) and the tourism scenario (right)

The increase in the average Moran's I on the customer target attribute indicates that the policy actions included in the tourism development scenario impact the clustering patterns of the creative firms. The results of the tourism development scenario show that creative firms are located near tourist information centres and customers (figure 15). This indicates that the development of creative tourism programmes policy action causes creative firms to cluster based on their customer target.



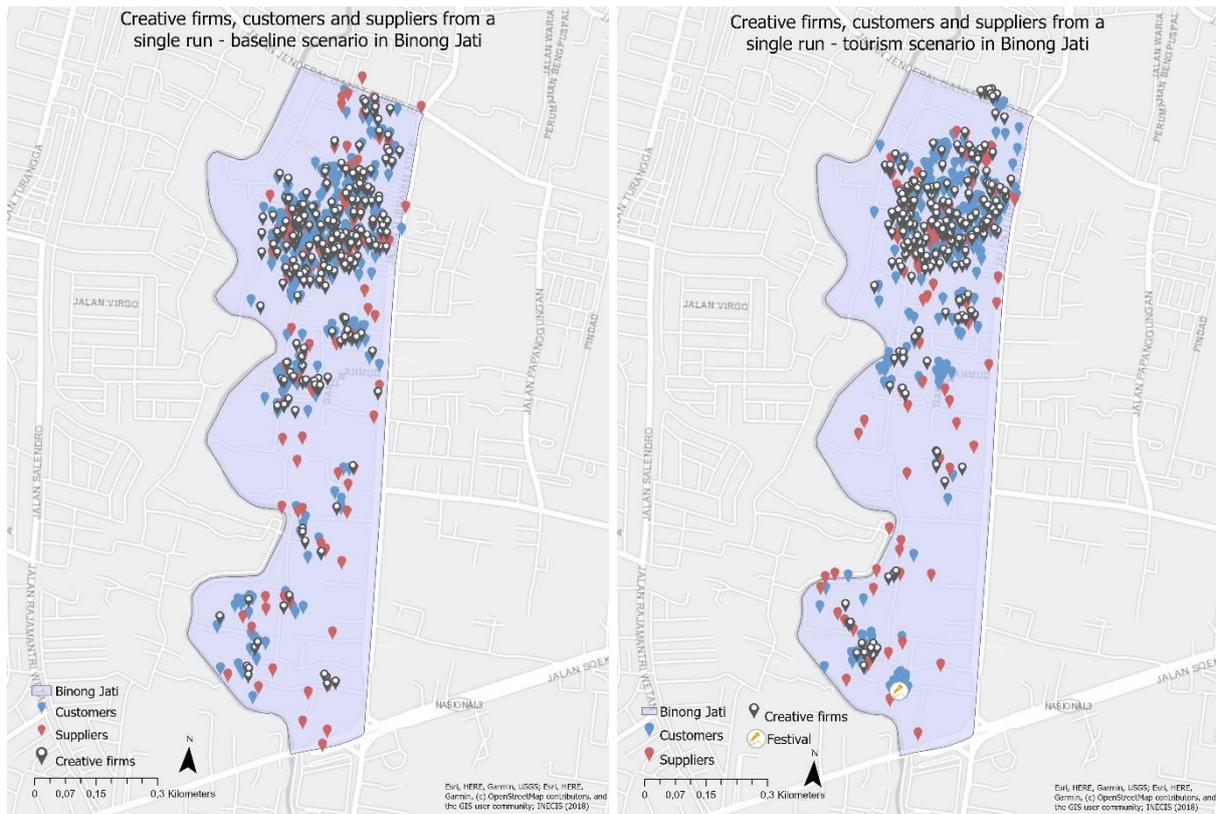


Figure 16: Map of the creative firms, customers, and suppliers from a single run in Binong Jati from the baseline scenario (left) and the tourism development scenario (right)

In their study, Menkshi & Brahल्ली (2019) also suggest that greater promotion of cultural and creative activities through the organization of fairs, exhibitions, celebrations, special days, and media advertising should be included in policies aimed at creative industries. However, based on the results of the tourism development scenario, this research suggest otherwise. The results from the tourism development scenario show that the establishment of a festival (or a similar activity) does not change the spatial distribution of the creative firms. This indicates that the organization of such cultural and creative activities should not necessarily be included in the policies aimed at the development of creative industries.

To summarise, it can be said that the development of creative tourism programmes and the establishment of a festival (or a similar activity) cause an increase in the number of creative firms that go bankrupt. The implementation of these policy actions are thus disadvantageous for both creative firms and the local government. In addition, the increase implicates that, contrary to the policy goal, the development of creative firms in terms of growth of the number of creative industry firms in Bandung decreases. The policy goal is thus not met. Also, the policy actions cause an increase in the clustering of creative firms based on their customer target. This increase is expected to be caused by the placement of tourist information centres as creative firms are often located in close proximity to these centres. The placement of a festival does not seem to affect the spatial distribution of the creative firms. Last, the results show minor changes in the clustering patterns based on main product, number of employees, number of customers and if the creative firm supplies to other firms.

#### 4.5 Comparison of the two scenarios

The industrial centres development and the tourism development scenario show similar results for the average nearest neighbor analysis. The difference in average nearest neighbor index is 0.03 in Binong Jati, 0.01 in Cigadung and 0.04 in Dago Pojok. There are also similar results for the average Moran's I on the main product attribute of creative firms (figure 12). The difference is 0.03 in Binong Jati and 0.02 in Cigadung and Dago Pojok. The implementation of the policy actions of both scenarios thus causes similar results on the average nearest neighbor analysis and the Moran's I on the main product.

Another similarity is the result of the Moran's I analysis on the number of customers. In both the industrial centres development and the tourism development scenario, creative firms are located



near other creative firms with a similar number of customers (figure 17).

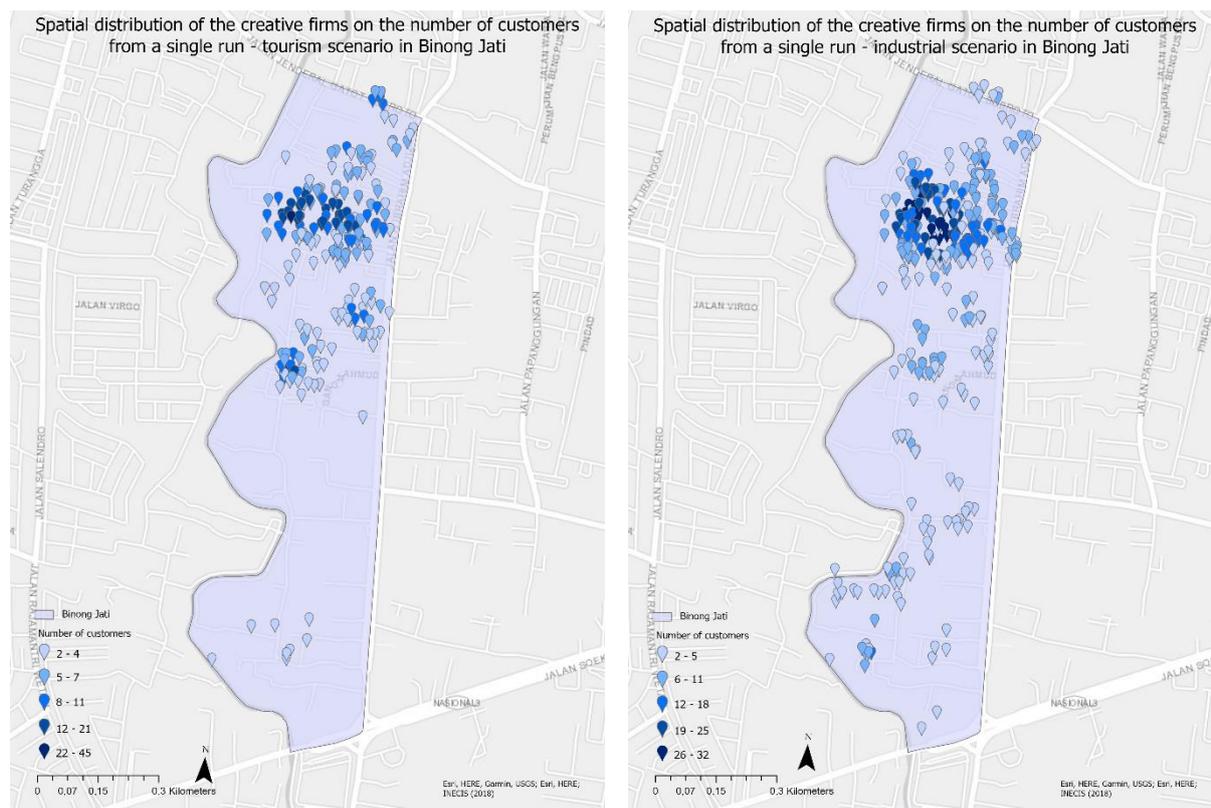


Figure 17: Map of the spatial distribution of the creative firms on the number of customers from a single run in Binong Jati from the tourism development scenario (left) and the industrial centres development scenario (right)

The results thus show that all the scenarios show clustering of creative firms. This finding matches the studies of Zhong (2012), Lazeretti, Capone & Boix (2012), Fahmi, Koster & Van Dijk (2016), and Gregory & Rogerson (2018). Their studies all conclude the same: creative firms tend to cluster. Different causes for the clustering are given in their studies e.g., wanting a greater internal network, wanting to exchange resources easily, and wanting to benefit from knowledge spillovers. Environmental factors are implemented in the ABM of this research. It is thus expected that creative firms cluster due to environmental causes. The results show that creative firms mainly cluster on their main product. This matches the cause of wanting to benefit from knowledge spillovers. In addition, it is expected that the concept that Frenken, van Oort and Verburg (2007) describe as related variety, is present as well.

A difference between the two scenarios is the average percentage of creative firms that go bankrupt in the model. The average percentages are higher in the tourism scenario than in the industrial centres development scenario (figure 9). Compared to the baseline scenario, the percentage of bankrupt creative firm decreases with 4% to 10% in the industrial centres development scenario, and increases with 9% to 11% in the tourism development scenario. This difference is of importance to both the creative industry firms as the local government as this can mean the difference between the survival or bankruptcy of a creative firm. This is considered a big impact and must thus be carefully considered by the local government.

Another difference is the average Moran's I value on customer target. In the industrial centres development scenario, the Moran's I results are not statistically significant ( $p > 0.05$ ) and thus do not give an indication on the spatial autocorrelation based on the customer target attribute. However, the tourism development scenario does have statistically significant results ( $p > 0.05$ ) on the average Moran's I. These values are 0.12, 0.12 and 0.16 which indicates low spatial autocorrelation of the creative firms based on the customer target attribute. This implicates that the policy actions in the tourism development scenario influences the spatial patterns of the creative firms. The implementation of tourist information centres is expected to cause this. Tourists locate in close proximity of the tourist information centres and the customer quality is calculated by the number of customers in close proximity. If there are a lot of customers in an area, for example near a tourist information centre, this location is more appealing. Creative firms will thus prefer this location. This can cause the clustering based on the customer target, as the creative firms will choose the location with more customers.



#### **4.6 Limitations and future work**

The ABM from this research is deemed plausible, but few improvements are suggested to implement in further research. The first improvement regards the definition of close proximity. It was assumed that close proximity indicates a walking distance from the creative firms. The values for the proximity to the creative firms is essential in the ABM as this determines where creative firms locate and if creative firms go bankrupt. More research on what distances or travel times are sufficient as close proximities for creative firms can lead to more accurate location choices and thus more accurate results.

The second improvement regards the supplier and customer choice of the creative firms. In the ABM of this research, the creative firms have one main supplier type and one main customer type. However, in the real-world, creative firms can have more than one supplier and customer type. This is also seen in the INECIS survey as creative firms sometimes have more than one supplier and customer.

The third improvement regards the specification of the growth of the number of employees. In the ABM of this research, the growth of the number of employees is solely dependent on the number of customers in close proximity. It is suggested to investigate if this is indeed the only factor or if there are more factors that determine the employee growth of creative firms.

The fourth improvement that is suggested is adding product behaviour to the ABM. In this research, the behaviour of the creative firms is the same for all firms, regardless of their main product. Product behaviour can be implemented by changing the behaviour of the firms based on the product they sell.

#### **4.7 Related work**

Previous research on the local government policies that are aimed at creative industries is often focused on the contents of policies themselves, and little on the implementation and the influence of these policies on the development of creative industries (Wiryo et al., 2015; Herawaty & Raharja, 2018; Menkshi & Braholli, 2019). In addition, little of the previous research is focused on the Global-South. This thesis has contributed to both fields as the impacts of local government strategies are assessed and the case study areas from this research are in Bandung, Indonesia, which is in the Global-South.

Further research can be done to assess other local government policies than used in this research. This enables to find out more about the influence of the local government strategies on creative industries in Bandung. In this research, six policy actions have been selected and two scenarios were set up based on these policy actions. Other policy actions can be selected to use in future research. For example, the policy actions that includes simplifying the licensing procedures and optimising the use of ICT in licensing services or the policy action that includes the development of collaboration between clusters and stakeholders can be selected. In addition, other themes for the scenarios can be selected such as the development of small industries (clusters) or technology, innovation, and creativity development.



## 5 Conclusion

The aim of this research was assessing the impacts of local government strategies on the development of creative industries in Bandung, Indonesia. Agent-based modelling was used to assess these impacts and three sub research questions are answered to reach this research aim.

The first sub research question in this research is: *“What are the policy actions of the local government policy strategies that are used to stimulate the development of creative industries?”*. The most recent policy action plans are the Bandung Spatial Plan 2011-2031, including the Bandung mid-term development plan from 2013-2018 and 2018-2023, the Bandung Tourism Development Master Plan 2012-2025 and the Bandung City Industrial Development Master Plan 2019-2039. The policy strategies with corresponding policy actions from these plans have been categorised into three main themes: 1) maintaining economic growth, 2) the development of industrial centres, creative industry clusters, and small and medium industries, and 3) the development of tourism.

The second research question is: *“What characteristics of creative firms and their environment are of importance for the development of creative firms?”*. The characteristics of creative firms that were found to be of importance in the development of creative firms are their customer target, suppliers, number of customers, location, main product, number of employees, and if the creative firm supplies to other firms. The proximity to external suppliers, external customers and other creative firms are also of importance. Accessibility to the right space to operate and access to markets are important environmental factors (Gregory & Rogerson, 2018). Another environmental characteristic important for the development of creative firms was the clustering of creative firms (Lazzeretti, Capone & Boix, 2012; Zhong, 2012; Fahmi, Koster & Van Dijk, 2016; Gregory & Rogerson, 2018). Clustering is of importance because spill-over effects arise. For example, clustering makes it easier for firms to work together and exchange resources.

The third research question is: *“What is the impact of the local government strategies on the development of creative firms?”*. To analyse the impact of local government strategies, an ABM was developed in which the characteristics and environment of creative firms from the second research question are translated. Three case study areas have been used, which are three kampungs (neighbourhoods) in Bandung. In the ABM, creative firms find a location based on four factors as identified in the second research question: distance to supplier, distance to customers, distance to similar firms, and distance to roads. A scenario-based analysis was conducted to analyse the effects of the local government strategies, as identified in the first research question, on the number of creative firms and their clustering. To do so, three scenarios have been set up in line with three distinct government strategies from the first research question: the baseline scenario (no additional policies), the industrial centres development scenario, and the tourism development scenario. The results showed that the average nearest neighbour index is similar in the three scenarios, varying from 0.62 to 0.70. In addition, the results showed that compared to the baseline scenario, the policy actions in the industrial centres development scenario decreased the average percentage of bankrupt creative firms (around 4%-10%). The tourism development scenario showed increases of this percentage (around 9%-10%). Finally, the results showed that the average Moran's I based on the customer target was the highest in the tourism development scenario.

The results of this thesis showed that the implemented local government strategies have different impacts on the development of creative firms. The policy actions that are directly aimed at creative firms, e.g., offer financing and workshops, impacted the development of creative firms as they caused more creative firms to establish and less creative firms to go bankrupt. The policy actions that are indirectly aimed at creative firms, e.g., establishing a festival and developing creative tourism programmes, impacted the development of creative firms as they caused more firms to go bankrupt. To ensure that policy actions can achieve the desired results, it is recommended that the government revises its policy strategies and corresponding policy actions. They should change the policy actions that are indirectly aimed at the creative firms to actions that are more directly aimed at creative industries. This research showed that the following policy actions are deemed the best for creative industry development: improving financing access, providing financial subsidies, offering training, and offering workshops. These policy actions are thus recommended to be expanded and included more often in the policy strategies aimed at the development of creative industries.



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## 7 Appendices

### 7.1 Appendix 1: INECIS Survey data question 13, 14, 15

Table 6: Answers to Q13 “What was the main reason why this business was started in this place?”

Answer	Total
Close to customers	4
Close to the city	1
Close to your home	11
It had land/space available at a good price	6
It was already here	18
Your family’s home	61
Other	65
<ul style="list-style-type: none"> <li>• Because Binong is known for its knitting centre x33</li> <li>• Close to similar businesses x7</li> <li>• Close to suppliers x5</li> </ul>	

Table 7: Answers to Q14 “Currently, what are the three main advantages of this location?”

Answer	Total
Close to suppliers	120
Close to customers	37
Close to the city centre	21
Close to transportation providers	16
Close to similar businesses	72
Close to your home	37
Close to business partners	22
Support by community/NGOs	4
Support by government	0
Access to public infrastructure (electricity, sewage, paved roads, etc.)	13
Access to land	10
Low cost of land	10
Others	44
<ul style="list-style-type: none"> <li>• Access to information x2</li> <li>• Binong is famous as a knitting centre x16</li> <li>• Central and complete</li> <li>• Close to good deposit</li> <li>• Close to logistic services x9</li> <li>• Close to SDM</li> <li>• Close to the workplace</li> <li>• Cool, far from the crowd.</li> <li>• Do not pay rent</li> <li>• Easy accommodation x2</li> <li>• Easy to find common motives</li> <li>• Far from other businesses, and the land prices are cheap</li> <li>• Lots of colleagues</li> <li>• Many buyers look for Binong which makes workers easy to find x4</li> <li>• Marketing and workforce x3</li> </ul>	



Table 8: Answers to Q15 “Currently, what are the three main disadvantages of this location?”

Answer	Total
Distance to suppliers	9
Distance to customers	16
Distance to the city centre	4
Distance to transportation providers	6
Distance to similar businesses	18
Distance to your home	1
Distance to business partners	1
Lack of support by community/NGOs	23
Lack of support by government	59
Lack of access to public infrastructure (electricity, sewage, paved roads, etc.)	22
Lack of access to land	37
High cost of land	24
Others	62
<ul style="list-style-type: none"> <li>• Competition with price and high price of the materials x9</li> <li>• Distribution for sales and raw materials x2</li> <li>• Due to the high prices of the land, it is difficult to have your own land/place for training for Jaipong here</li> <li>• If it rains mobility becomes a problem x2</li> <li>• It's hard to find workers x26</li> <li>• Located in a dense area x3</li> <li>• Many people in Bandung do not really know its business location because it's in an alley</li> <li>• Narrow parking place x2</li> <li>• Next to the river</li> <li>• No place for selling products (displaying products to consumers)</li> <li>• Not enough land</li> <li>• Quality of the product is not good</li> <li>• Small road and a lot of traffic in the street x4</li> <li>• Sound pollution</li> <li>• The rent price is high</li> <li>• There are limits on working hours</li> <li>• There are no export opportunities x3</li> <li>• Untrusted suppliers</li> </ul>	



## 7.2 Appendix 2: Validation outputs

Table 9: Summary of the validation results

Kampung → Attribute ↓	Binong Jati	Cigadung	Dago Pojok
Number of initial creative firms	104	10	8
Number of created creative firms	50	50	50
Average number of survived creative firms	116	31	32
Average number of bankrupt creative firms	38	29	26
Average % bankrupt creative firms	25%	48%	45%



Figure 18: Heat map of the creative firms from the validation data from INECIS (left) and a heat map of the newly created creative firms from the combined validation runs (right) both in Binong Jati

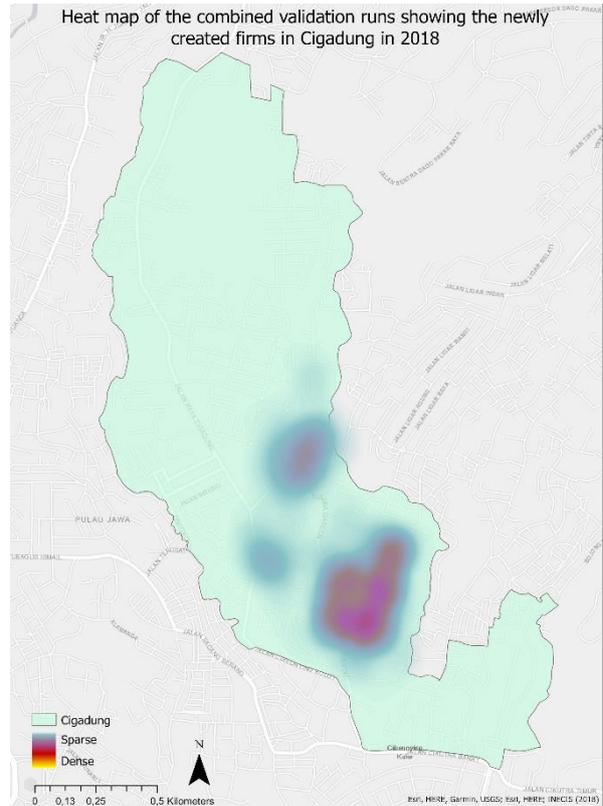
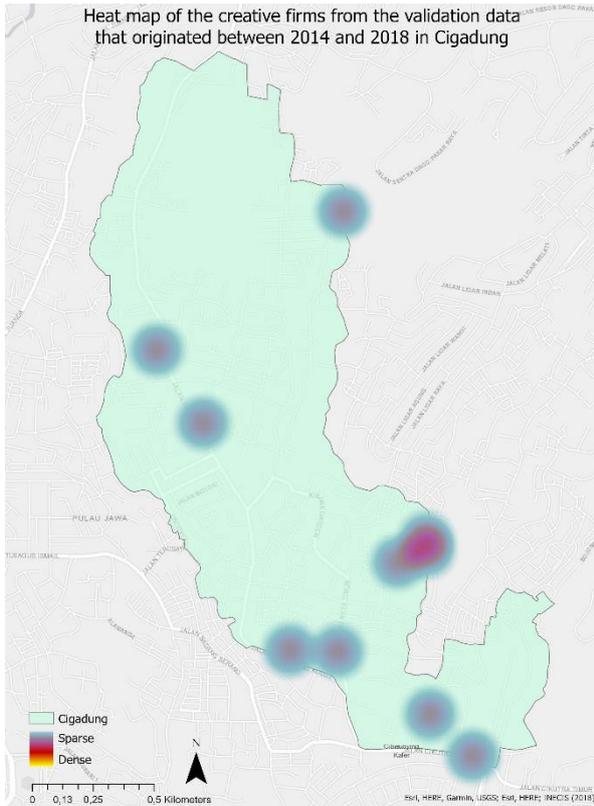


Figure 19: Heat map of the creative firms from the validation data from INECIS (left) and a heat map of the newly created creative firms from the combined validation runs (right) both in Cigadung

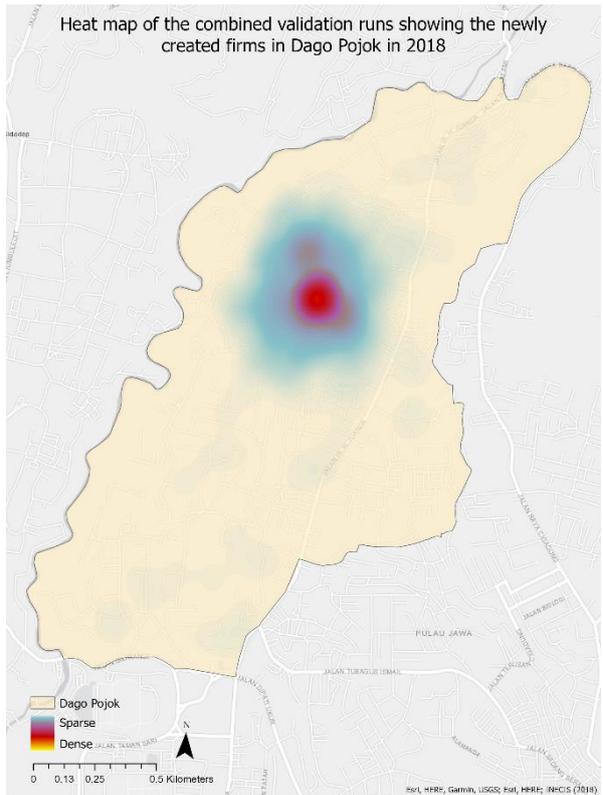
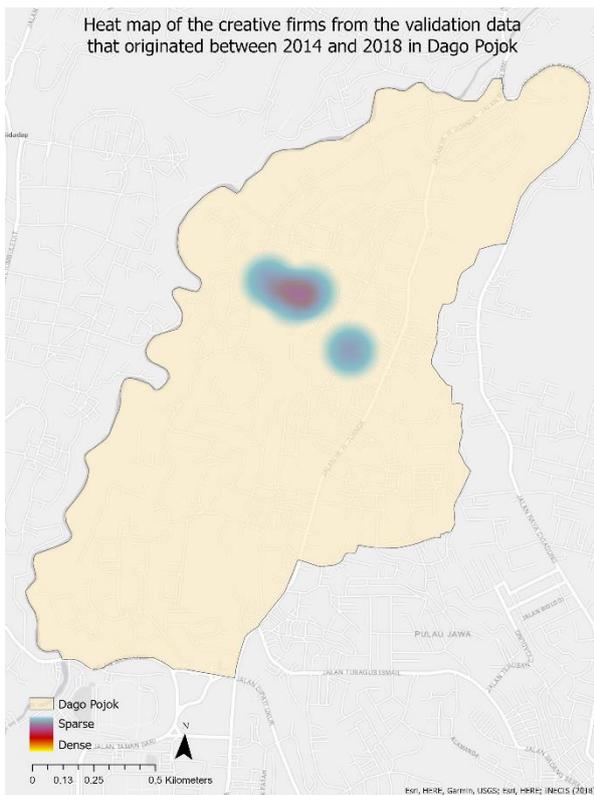


Figure 20: Heat map of the creative firms from the validation data from INECIS (left) and a heat map of the newly created creative firms from the combined validation runs (right) both in Dago Pojok



### 7.3 Appendix 3: Scenario results

Table 10: Summary of the baseline scenario results

Kampung → Attribute ↓	Binong Jati	Cigadung	Dago Pojok
Number of initial creative firms	104	10	8
Number of created creative firms	200	200	200
Average number of survived creative firms	234	164	161
Average number of bankrupt creative firms	70	46	47
Average % bankrupt creative firms	23%	22%	23%
Average nearest neighbour	0.65 (p<0.01)	0.69 (p<0.01)	0.70 (p<0.01)
Average Moran's I: main product	0.19 (p<0.05)	0.31 (p<0.05)	0.31 (p<0.05)
Average Moran's I: customer target	0.06 (p>0.05)	0.02 (p>0.05)	0.05 (p>0.05)
Average Moran's I: number of employees	0 (p>0.05)	0 (p>0.05)	0 (p>0.05)
Average Moran's I: number of customers	0.45 (p<0.05)	0.36 (p<0.05)	0.48 (p<0.05)
Average Moran's I: if the creative firm supplies to other firms	0 (p>0.05)	-0.01 (p>0.05)	0.01 (p>0.05)

Table 11: Summary of the industrial centres development scenario results

Kampung → Attribute ↓	Binong Jati	Cigadung	Dago Pojok
Number of initial creative firms	104	10	8
Number of created creative firms	300	300	300
Average number of survived creative firms	329	266	268
Average number of bankrupt creative firms	75	44	40
Average % bankrupt creative firms	19%	14%	13%
Average nearest neighbour	0.65 (p<0.01)	0.66 (p<0.01)	0.67 (p<0.01)
Average Moran's I: main product	0.21 (p<0.05)	0.28 (p<0.05)	0.28 (p<0.05)
Average Moran's I: customer target	0.04 (p>0.05)	0.02 (p>0.05)	0.03 (p>0.05)
Average Moran's I: number of employees	0 (p>0.05)	0.02 (p>0.05)	0.01 (p>0.05)
Average Moran's I: number of customers	0.44 (p<0.05)	0.36 (p<0.05)	0.48 (p<0.05)
Average Moran's I: if the creative firm supplies to other firms	0 (p>0.05)	0 (p>0.05)	0 (p>0.05)

Table 12: Summary of the tourism development scenario results

Kampung → Attribute ↓	Binong Jati	Cigadung	Dago Pojok
Number of initial creative firms	104	10	8
Number of created creative firms	200	200	200
Average number of survived creative firms	208	143	137
Average number of bankrupt creative firms	96	67	71
Average % bankrupt creative firms	32%	32%	34%
Average nearest neighbour	0.62 (p<0.01)	0.65 (p<0.01)	0.63 (p<0.01)
Average Moran's I: main product	0.18 (p<0.05)	0.26 (p<0.05)	0.26 (p<0.05)
Average Moran's I: customer target	0.12 (p<0.05)	0.12 (p<0.05)	0.16 (p<0.05)
Average Moran's I: number of employees	-0.04 (p>0.05)	0.04 (p>0.05)	0.001 (p>0.05)
Average Moran's I: number of customers	0.34 (p<0.05)	0.22 (p<0.05)	0.39 (p<0.05)
Average Moran's I: if the creative firm supplies to other firms	0.01 (p>0.05)	-0.03 (p>0.05)	0 (p>0.05)



#### **7.4 Appendix 4: Table of content of added file**

Table of Content of the .zip file that accompanies the thesis report:

- Report (PDF)
- INECIS survey questions - format 2019 (.docx)
- NetLogo code (.nlogo)
- Input data (.shp)
  - o Road network visualization Binong Jati
  - o Road network values Binong Jati
  - o Initial creative firms Binong Jati
  - o Administrative borders Binong Jati
  - o Road network visualization Cigadung
  - o Road network values Cigadung
  - o Initial creative firms Cigadung
  - o Administrative borders Cigadung
  - o Road network visualization Dago Pojok
  - o Road network values Dago Pojok
  - o Initial creative firms Dago Pojok
  - o Administrative borders Dago Pojok
- Results validation (.csv)
- Results scenario analysis (.csv)