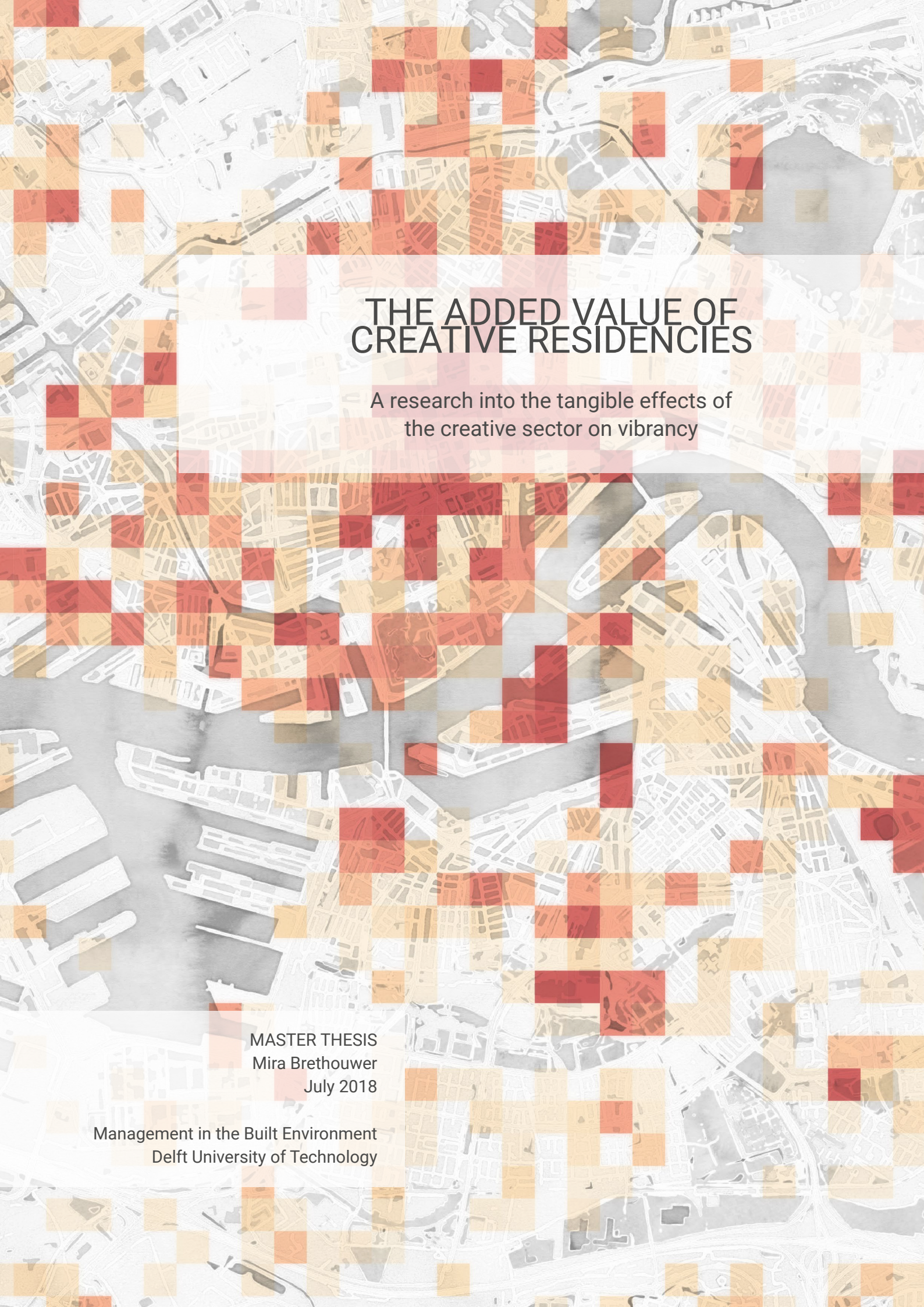

THE ADDED VALUE OF CREATIVE RESIDENCIES

A research into the tangible effects of the creative sector on vibrancy

MASTER THESIS
Mira Brethouwer
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Management in the Built Environment
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the creative sector on vibrancy

COLOPHON

ANNA MIRA BRETHOUWER
Student number: 4076672
Address: -
Phone: -
E-mail: -

DELFT UNIVERSITY OF TECHNOLOGY
Management in the Built Environment
Real Estate Management - Adaptive Reuse
First Mentor: Hilde Remøy
Second Mentor: Philip Koppels

GRADUATION COMPANY
Company: Geophy
Address: Papenstraat 5, Delft

June 28, 2018

PREFACE

Transformation of vacant real estate is 'hot', especially since the financial crisis of 2008. New ways of working and a shift within many companies from expansion to agility have led to a declining demand for office space. This trend has left many buildings obsolete, even though some of these buildings may have lots of potential. Transformation of these vacant or outdated buildings is the future and I believe this will become a more and more important part of building practices in the years to come.

The graduation project of Anniek van der Hoek (2016) focused on a specific type of transformation: refitting vacancy for the creative industry. In her research, it is stated that the creative sector is not only the fastest growing sector in the Netherlands and a pioneer for working standards, but also has a positive effect on the neighbourhood quality. Inspired by this research, and being fascinated by this rising creative sector, it sparked my interest in the tangible effect of these types of projects on the urban economy and urban competitiveness.

One of the many transformation projects for the creative sector in the Netherlands is the Schieblock in Rotterdam, close to Rotterdam Central station. Before the financial crisis, there were plans to demolish the Schieblock and build a collection of new high-rise towers at it's location. Due to the economic downturn however, these initial plans were adjusted into a more flexible planning that would attract young, creative businesses to fill the vacant space. The area surrounding the building seems to be 'booming' now, attracting other initiatives and young people that want to work and live in the area. Nonetheless, with the economy on the rise again, large-scale commercial redevelopment plans for the area re-emerge.

The case described above gives rise to the question whether creative residencies like this should be preserved in order to retain a lively, vibrant area. It is however quite challenging to objectively measure the tangible external effects of these type of residencies, as it is with many phenomena in the field of urban economics and dynamics. Nonetheless I believe that in many branches of the real estate practice, it is still too common to make decisions on gut feelings, network relations and limited amounts of objective insight. Therefore, in this thesis, I aim to provide a more objective approach in determining the added value of creative residencies, by combining theory, emerging data sources and statistical modelling.

I would like to give a special thanks to my supervisors, Hilde Remøy and Philip Koppels. Furthermore, I would like to thank my colleagues from Geophy, in particular Marijana Novak, Ali Ayoub and Rawand Hawiz, for all their support. Without their enthousiasm and positive energy, the end result would not have been the same and my experience of graduating much less enjoyable.

I wish you an interesting read,

Mira Brethouwer

28-06-2018

SUMMARY

THE ADDED VALUE OF CREATIVE RESIDENCIES

A research into the tangible effects of the creative sector on vibrancy

ABSTRACT

Besides being the fastest growing sector in the Netherlands, and a pioneer in working standards, the creative sector is believed to have a positive effect on economic growth. Multi-tenant buildings occupied by creative sector companies, i.e. creative residencies, are thus assumed to improve the neighborhood's socio-economic quality. A lack of objective insights however, gives rise to the discussion about whether the creative sector indeed provides added value for it's location, and if so, what this added value exactly entails.

Therefore, this thesis provides a more objective approach in measuring the added value of creative residencies, by combining theory, emerging data sources and statistical modelling. Using Jane Jacobs' theory on vibrant neighborhoods and data retrieved from the social media platform Facebook, a vibrancy model is constructed through factor analysis. This model is then applied to the city of Rotterdam, to assess the impact of four different creative residencies.

The results show that these cases are indeed located within vibrant clusters. However, the exact results, in terms of dispersion of the clusters and change over time, differ per case. Based on a cross-case comparison, the distinguishing case characteristics influencing the contrasting results are assessed, leading to a number of hypotheses. These hypotheses however, are still open for interpretation, providing opportunities for further research. Nevertheless, a strong connection between a creative residency and it's neighborhood, through the presence of diverse hospitality and an open, public character, appears to contribute to a more dispersed vibrant cluster, and thus a higher added value for the neighbourhood in terms of vibrancy.

KEYWORDS

City vibrancy, Creative Residency, Impact Assessment, Factor Analysis

INTRODUCTION

With his book 'The rise of the creative class' in 2002, Richard Florida raised attention for the creative industry worldwide. He highlighted the importance of the creative class for urban development and even stated that the job opportunities within the creative professions are a driving force behind economic growth (CBS, 2011). However, objective insights into the positive effects of the presence of creative businesses on a local scale are still lacking. This leads to discussion about whether the creative sector indeed provides added value for it's location, and if so, what this added value exactly entails.

Besides, it is not very likely that a cluster of some creative businesses causes an economic boom in that city or city district directly. It is far more likely to improve some socio-economic aspects of an urban area. It could for instance improve vibrancy, in an area that might have been deprived, dull, or mono-functional before. In turn, this vibrancy is believed to lead to social and economic improvement of the area in a broader sense.

It is however quite challenging to objectively measure a concept like vibrancy, as it is with many phenomena in the field of urban economics and dynamics. These issues tend to be very dynamic, and may be relevant on a small spatial scale, leading to a demand for quantifiable data that is fine-grained and updated frequently.

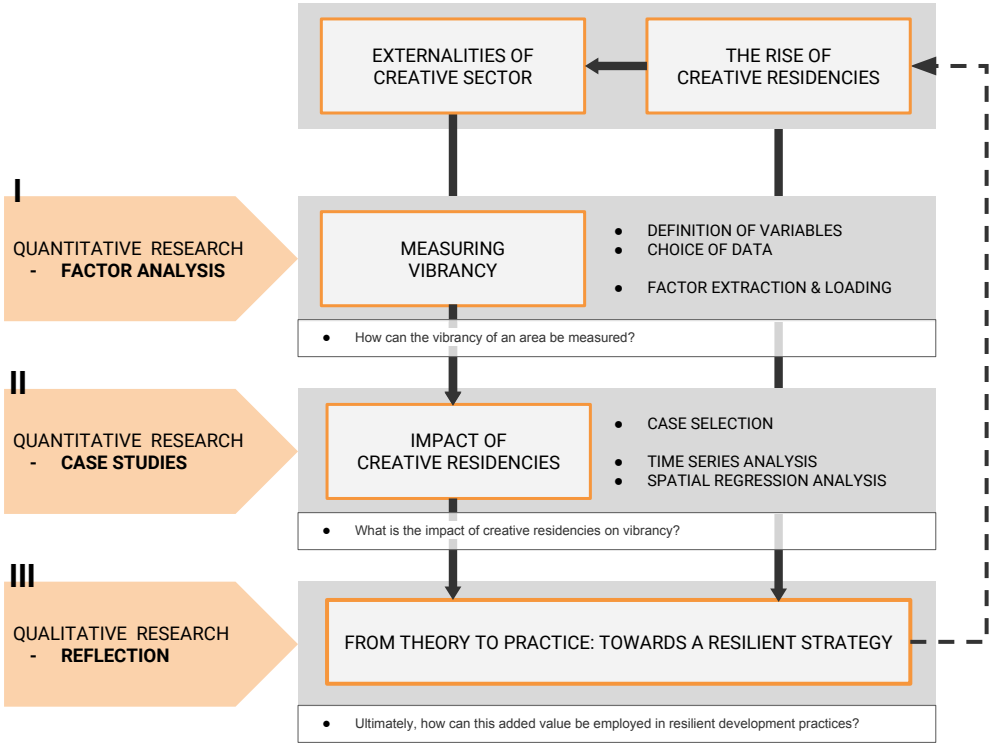

Figure 1: Research design

While adding to the evidence-base for the socio-economic added value of creative residencies, more insight into the added value of creative hubs could provide guidelines for developers and initiators of creative residencies. Moreover, it would provide the logical rationale for creating, preserving and stimulating creative hubs throughout a city, also in more prosperous economic times.

The aim of this research is therefore to propose a methodology to measure if the positive impact of the creative sector on the vibrancy of it's urban area exists, and to what extent. Ultimately, the goal is to recommend approaches to how the results may be used in practice, in order to create a resilient urban area. Herewith, the main research question to answer is:

How can the added value of creative residencies for an area's vibrancy be determined and used to design a resilient urban strategy?

METHODOLOGY & RESULTS

In order to find answers to the proposed question, a mixed-method research strategy is used. As illustrated in figure 1, each part of the research design relates to a different subquestion and employs a different methodology.

	Physical	Social	Economical
1. Mixed Land Use			Economic functions Day-/Night economy
2. Small Blocks	Building block size Street pattern		
3. Building Diversity	Age of buildings Upkeep of buildings		
4. Density	Building Density	People density People diversity	

Table 1: Physical, Social & Economical aspects included in Jacobs' conditions for diversity (own figure)

PART I

First of all, factor analysis is used to develop a model that is able to measure vibrancy. A theoretical framework is given, both to underpin the indicators used to construct the latent concept vibrancy, and to explain the types of data that are used. Using factor extraction and loading, an answer is given to the first research question.

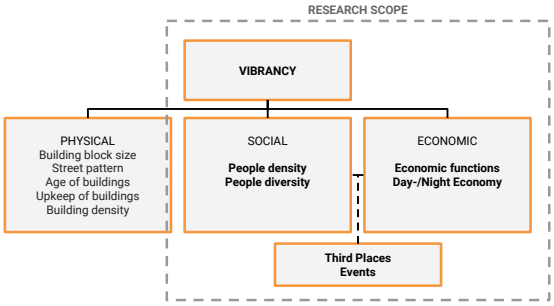

Figure 2: Indicators for Urban Vibrancy

Although one can perceive whether an area is vibrant, directly and objectively measuring it is a challenge. Not only is vibrancy prone to subjectivity, it is also very dynamic and includes a multitude of different aspects, ranging from ethnic diversity to the multifunctionality of the built environment. In order to operationalize the concept of vibrancy, it is therefore essential to explore what specific aspects, or factors, are indicators of vibrancy.

Building upon Jane Jacobs' theory about city vibrancy, there are four important conditions for a vibrant urban neighbourhood, as shown in table 1. The physical aspects of Jacobs' conditions, apply more to urban planning of the 'hardware'. However, in this research the impact of a relatively small scale, functional intervention in the built environment (i.e. the presence/creation of a creative residency) on the vibrancy of that district is assessed. The presence of a creative residency is expected to have an impact on socio-economic aspects, rather than having an effect on the physical lay-out of the neighbourhood. Therefore, the focus in constructing a vibrancy model is on the social and economical aspects included in Jacobs' theory, as identified in table 1.

Building further upon Jacobs' theory, it is believed that not all places are equal, within the precondition of mixed land use. De Nadai et al. identify the importance of 'third places' - locations that are not homes (first places) or places of employment (second places) (De Nadai, et al., 2016). Third places are able to "foster community and communication among people outside home and work; they are places where people gather primarily to enjoy each others' company" (Oldenburg, 1989).

In the same way, events are usually meant as a social gathering, being a third place on it's own. Moreover, events are able to show hotspots in terms of people density. When an event is happening, depending on it's scale, a lot of people are expected to be attracted to that certain area. Therefore, a place where a lot of events are organized can automatically be seen as more dense in terms of people, and thus more vibrant.

The relative importance of third places, and the possibility to track organized events, thus add another two indicators to the list. These two fall in between the economy and social categories, as both provide possibilities for socializing, but also entail economic aspects.

The presence of a creative residency is expected to have an impact on socio-economic aspects, rather than having an effect on the physical lay-out of the neighbourhood. Therefore, the focus in constructing a vibrancy model is on the social and economical aspects included in Jacobs' theory. The socio-economic indicators as summarized in figure 2, are translated into the following variables:

- *Land Use Mix (or Economic functions)*
- *Venues (or Third Places)*
- *Day-/ Night Economy*
- *People Diversity*
- *Events*
- *People Density*

A second challenge in measuring vibrancy, lies in the availability and collection of data. Traditional data used to address urban issues tends to be static, and aggregated on coarse spatial levels. The emergence of new data sources provides opportunities to test traditional theories and hypotheses with more sophisticated models.

A choice for using data extracted from the Facebook platform has been made, which will feed the Venues, Day-/Nighteconomy, Events and People Density variables. This data however tends to be biased, as the data only relates to the people and businesses using a certain social media platform. Nevertheless, it is believed that businesses making use of social media platforms have a higher exposure to the public and therefore contribute more to the vibrancy of an area. Also in terms of visitors, it is believed that the largest chunk of people contributing to an area's vibrancy falls within a certain age range and class that is generally using social media. Therefore, the bias is in this case not expected to distort the results too much. For the Land Use Mix and People Diversity variables respectively data from the dutch land register and dutch census are used.

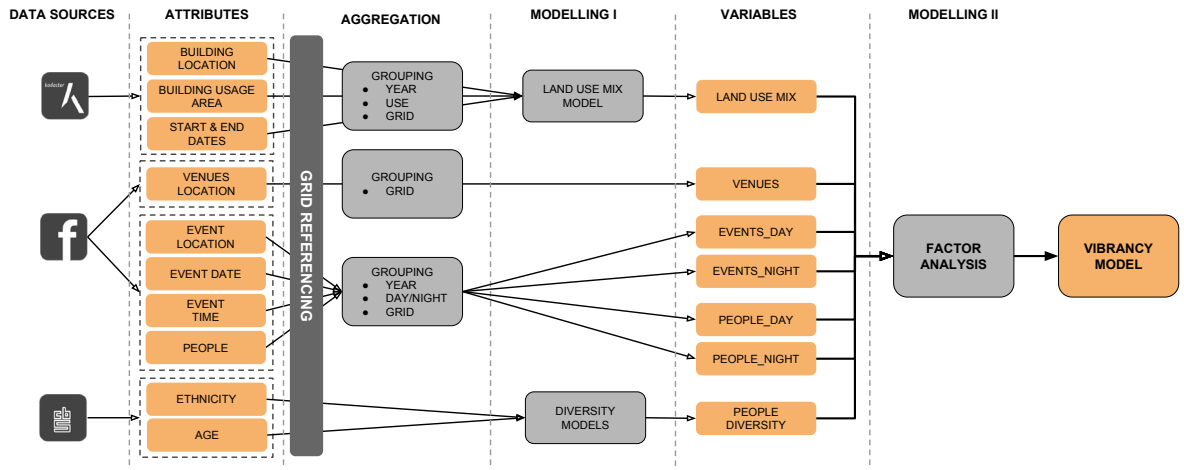

Figure 3: Input for the Factor Analysis.

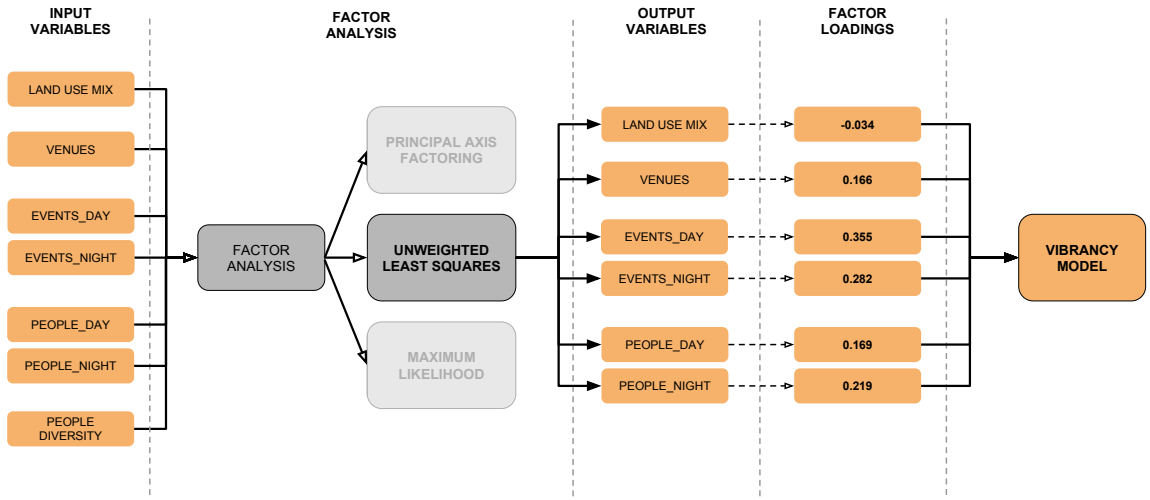

Figure 4: Output of the Factor Analysis.

To be able to integrate the different datasets with each other, grid referencing is used. A grid of 100 by 100 meter squares is created, in which each single grid contains an unique identifier. All the datasets, with the exception of the census data, include a spatial attribute in the form of geographic coordinates. Using these geographic coordinates, the data points are spatially joined with the grid and assigned one of the grid IDs. As the created grid exactly overlaps the grid used by the census data, it is also fairly easy to spatially join the census data with the new grid. Figure 3 shows the overall data-wrangling process leading up to the factor analysis.

Factor analysis is a statistical method used to find joint variability among observed, correlated variables in response to unobserved latent variables. Basically, the factor analysis reduces all the information included in the different variables to fewer factors, that are best able to explain the variability in the observed variables.

There are several 'common' factor analysis methods, usually generating similar results. Comparing the results of the different methods and trying different sets of variables, especially the interpretability of the outcomes is taken into account. The best interpretable and explainable result is found when extracting 1 factor using the unweighted least squares method, discarding the people diversity variables. The output of the factor analysis and factor loadings, i.e. the weights of the different variables onto the factor, are shown in figure 4.

With the outcomes of the factor analysis, it is possible to construct the vibrancy model, as shown below. The model calculates a vibrancy score Vfor grid gin year t, by multiplying the standardized values of each variable by it's factor loadings. The model uses standardization of variables using the mean and standard deviation of the total dataset, i.e. for the data of the entire city of Rotterdam for the years 2011-2017 (c).

With the first model an overall increase or decrease over time can be observed. However, to assess the growth in a certain grid relative to the level of the vibrancy scores in that grid, a second function is used, as shown below as well. With this second formula, the relative percentage change can be used to compare the level of vibrancy in two years, while taking into account the level of vibrancy in that area.

(1)

$$V_{gt} = 0.166 \times \frac{Venues_{gt} - \overline{Venues_c}}{SD[Venues_c]} + 0.355 \times \frac{Events\_Day_{gt} - \overline{Events\_Day_c}}{SD[Events\_Day_c]} + 0.282 \times \frac{Events\_Night_{gt} - \overline{Events\_Night_c}}{SD[Events\_Night_c]}$$
$$+ 0.169 \times \frac{People\_Day_{gt} - \overline{People\_Day_c}}{SD[People\_Day_c]} + 0.219 \times \frac{People\_Night_{gt} - \overline{People\_Night_c}}{SD[People\_Night_c]} + (-0.034) \times \frac{LUM_{gt} - \overline{LUM_c}}{SD[LUM_c]}$$

(2)

$$\Delta V_{gt} = \frac{V_{gt} - V_{gt-1}}{V_{gt-1}}$$

With the constructed models, the vibrancy scores for every grid can be calculated, and subsequently be plotted on the map of Rotterdam to visualize their spatial layout, as shown in figure 5.

Figure 5: Vibrancy scores for the city of Rotterdam in 2017.

PART II

Subsequently, the impact on vibrancy of four different creative residencies in Rotterdam is assessed. Descriptive statistics are used to find out what the impact on vibrancy of the creative residencies is. These results will then be related to identifying characteristics of the cases, in order to find answers to the second research question.

Within the city of Rotterdam, four cases are selected that meet the criteria for a creative residency:

- Schiekadeblok, Rotterdam
- Keilewerf, Rotterdam
- Creative Factory, Rotterdam
- Het Industriegebouw, Rotterdam

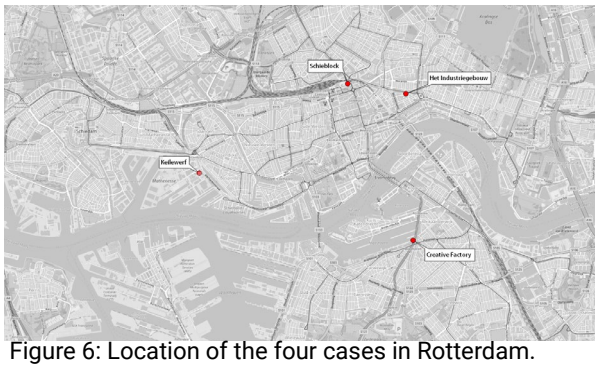

Figure 6: Location of the four cases in Rotterdam.

SPATIAL ANALYSIS

For each grid, vibrancy scores are calculated using the vibrancy model constructed in part I of this report. Subsequently a closer look will be taken into the different cases, at a 1:10.000 scale, as shown in figures 7-10. These figures most importantly indicate whether a residency is located in a vibrant cluster and whether or not this cluster is large and spread-out or small and concentrated.

TIME SERIES ANALYSIS

Furthermore, for each year in the period from 2011 until 2017, the outcomes of both models are plotted into graphs, showing the changes in vibrancy. This is done for the 100 by 100 meter grid the residency is located in (first belt), but also for the grids adjacent to this grid (second belt), and the grids adjacent to those (third belt). These different belts of areas surrounding the creative residencies are used to assess whether the changes in vibrancy can also be observed in a wider area, indicating more wide-spread externalities, and thus more added value for the area. The results of both models over time are shown in figure 11-18.

Figures 7 - 10: Heatmaps surrounding Schieblock, Creative Factory, Keilewerf & Het Industriegebouw.

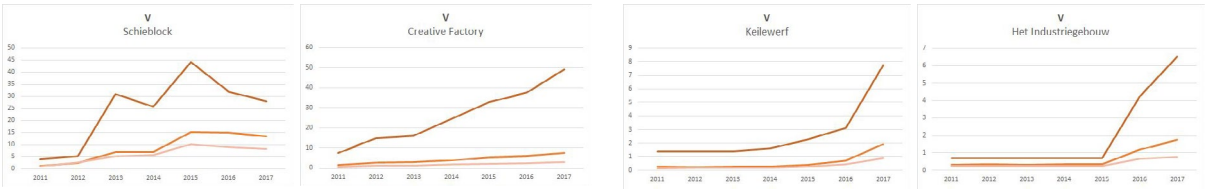

Figure 11 - 14: Vibrancy scores for the 1st, 2nd and 3rd belts of the Schieblock, Creative Factory, Keilewerf & Het Industriegebouw.

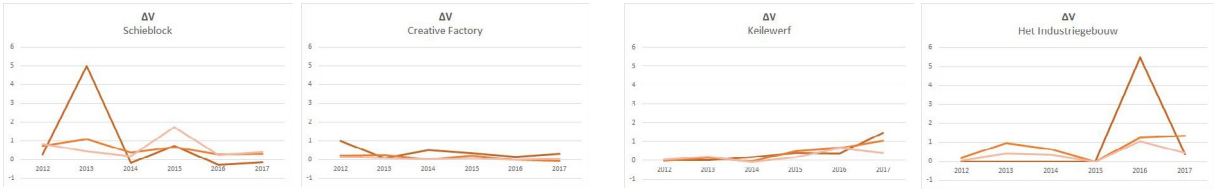

Figure 15 - 18: Relative percentage changes for the 1st, 2nd and 3rd belts of the Schieblock, Creative Factory, Keilewerf & Het Industriegebouw.

CROSS-CASE COMPARISON

The final part of the case study entails the cross-case comparison of the outcomes, with the aim of relating contrasting results to distinguishing characteristics of the cases, like the location within the city, the size, the connection with hospitality, etc. This way, aspects of creative residencies influencing their impact on vibrancy can be identified. The distinguishing case characteristics are summarized in table 2.

In order to compare contrasting results in terms of vibrancy for the four different cases, an assessment is made on their performance relative to one another. The case results are rated on a scale from - - to ++, as shown in table 3.

	Schieblock	Creative Factory	Keilewerf	Het Industriegebouw
Year of Initiation	2002/2009	2008	2015	2016/2017
No. companies	85	25	80	200
GFA	12.000 m2	2.500 m2	6.000 m2	22.000 m2
Public function	+	-	+	++
Location	Central	South	West	Central - East
FSI	2.05	0.82	0.72	1.30
Prominent Land Use	35.7% offices	60.4% residential	32.8% industrial	57.4% residential

Table 2: Case characteristics combined

	Schieblock	Creative Factory	Keilewerf	Het Industriegebouw
SPATIAL				
Dispersion of clusters	++	-	+	+
TIME				
Vibrancy score levels	++	++	+	+
Relative percentage change	+/-	--	-	+

Table 3: Assessment of the case results.

Connecting the distinguishing characteristics of the four cases, as outlined in table 2, to the contrasting results in terms of vibrancy, as assessed in table 3, a number of theoretical hypotheses can be generated:

- *Hypothesis 1:* *A connection with the neighborhood, through the presence of diverse hospitality and an open, public character, contributes to a more dispersed vibrant cluster.*
- *Hypothesis 2:* *A central location and minimization of physical boundaries will positively impact the dispersion of vibrant clusters.*
- *Hypothesis 3:* *The regular organization of large-scale events, will lead to high vibrancy scores for the concentrated cluster surrounding a creative residency.*
- *Hypothesis 4:* *The opening of a creative residency causes a boost in that area's vibrancy.*
- *Hypothesis 5:* *After the opening, new developments surrounding, or connected to, a creative residency, may further boost the area's vibrancy.*

PART III

CONCLUSIONS

Building upon Jacobs' theory about vibrancy, and updating it to the 21st century by adding the importance of events and 'third places', a relatively simple theoretical model of vibrancy is constructed. By combining user-generated social media data with more traditional datasets retrieved from the dutch land register and the dutch census bureau, a model is generated employing some of the advantages of both big data and traditional data.

Using factor analysis, the multiple indicators from the theoretical model can be combined into one mathematical model, and the weights of their respective coefficients are determined.

Overall it is found that the creative residencies are indeed located in vibrant clusters, which is in line with the expectations. However, the size and spread of these clusters, indicating positive externalities, appear to be very much influenced by the character and physical location. Physical boundaries can block the linkage of a residency with it's surroundings, hindering spin-offs and therefore the positive externalities. Moreover, the importance for a public face of the residencies is underpinned. A lack of connection with the area, leads to less widespread effects, and thus a declining added value for the area. The residencies that incorporate hospitality, organization of events and have an open character are better able to draw attention and people to the area.

The findings and results are able to provide some basic guidelines, for both the development of future creative residencies as well as the improvement of existing ones:

- When initiating a creative residency with the purpose of boosting the vibrancy of an area, just a collection of creative companies won't do the trick. Combining creative companies with hospitality, events and a public face in general seems to hold the key to being an attractive hotspot.
- An area that knows a lot of physical boundaries and a low accessibility is unlikely to work on it's own. However, it is possible to achieve vibrancy in a secluded area, as illustrated by the Keilewerf. In this case, special attention to creation of physical linkages, and minimizing physical boundaries is recommended.
- On the other hand, achieving significant impact in an area that is more accessible and attracts more people already, is difficult as well. A central location is possible, but should provide something extra for the area. In that case a creative residency might still have a positive impact in these spots, as illustrated by Het Industriegebouw.

DISCUSSION

In contrast to vested theories, it is not a given, at least not on a local, intra-city scale, that a creative hub will increase the vibrancy, and therefore supposedly improve socio-economic aspects as well. Although the relative importance of a public face is not something unexpected, explicit recommendations regarding this, have not been found in existing literature.

The most important limitations of this research are related to the constructed model, and more specifically the limited number of variables and the availability and accessibility of data. Overall, vibrancy remains a concept that is hard to comprehend within a few variables. Further research within the topic of urban vibrancy should take these limitations in mind and try to improve them. When looking at additional variables, these could be related to the spatial and physical lay-out of areas, like building density, accessibility and building upkeep, but also other proxies for the density and diversity of people and visitors could be added. Besides, for instance network-theory could make this sort of study much more profound, as specific relationships and connections between different places could be taken into account.

The aim of this research has been to quantify the concept of vibrancy, yet it has proven that without any qualitative interpretation the data remains meaningless. This is in line with the belief that big data is not as objective and value-free as one might think and underpins that contextual and domain-specific knowledge is required when analysing and interpreting the results.

RECOMMENDATIONS

The research provides straightforward and interpretable results and guidelines for developers and initiators of creative residencies. Besides, it incites municipalities to provide permits for hospitality businesses and (outdoor) events and festivals, as these appear to be the most important factors in the added value of creative residencies. This way, the results can be employed as driver for future transformation projects for the creative sector. It advocates the preservation of existing residencies and further development of future-proof residencies to accommodate the upcoming creative class, leading to a more diverse, inclusive urban area.

Building further upon the vibrancy model constructed in this research, interesting opportunities for further research can be found in researching the effect of an increasing vibrancy on other indicators of urban regeneration. Besides, the results of this research have led to many more hypotheses regarding the specific characteristics influencing the dispersion and extend of this impact. Testing these hypotheses, will be a valuable continuation of this research and could generate more specific and substantiated recommendations for resilient development practices. Furthermore, the method used in this research could be applied to other interventions in the built environment as well, assessing for instance the impact of the creation of a public park, shopping mall, or new iconic bridge.

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TABLE OF CONTENT

INTRODUCTION

1. INTRODUCTION

1.1. Lack of Objective Insights

With his book 'The rise of the creative class' in 2002, Richard Florida raised attention for the creative industry worldwide. He highlighted the importance of the creative class for urban development and even stated that the job opportunities within the creative professions are a driving force behind economic growth (CBS, 2011). However, objective insights into the positive effects of the presence of creative businesses on a local scale are still lacking. This leads to discussion about whether the creative sector indeed provides added value for it's location, and if so, what this added value exactly entails.

Besides, it is not very likely that a cluster of some creative businesses causes an economic boom in that city or city district directly. It is far more likely to improve some socio-economic aspects of an urban area. It could for instance improve vibrancy, in an area that might have been deprived, dull, or mono-functional before. In turn, this vibrancy is believed to lead to social and economic improvement of the area in a broader sense.

1.2. Quantifying Urban Dynamics

It is however quite challenging to objectively measure a concept like vibrancy, as it is with many phenomena in the field of urban economics and dynamics. These issues tend to be very dynamic, and may be relevant on a small spatial scale, leading to a demand for quantifiable data that is fine-grained and updated frequently.

Researchers however have been operating in data deserts, as much of what we know about cities has been extracted from small-data studies, characterised by data scarcity (Miller, 2010). In the cases where larger datasets are involved, conventional urban data such as national censuses, have limited capacities to give insights into the spatiotemporal dynamics of cities, due to infrequent updates, a generally coarse spatial scale and a limited number of variables (Psyllidis, 2016; Kitchin, 2013). However, the emergence of big urban data sources, like mobile phones, sensors and social media, holds the promise for a shift from studies characterised by data-scarcity, static snapshots and a coarse aggregation, to research that builds upon a massive pool of dynamic data, entailing high resolutions.

1.3. Demand for Resilience

In practice, more objective insights could be very helpful as well. Since the economic crisis of 2008, many public and private parties have lacked the economic resources to build pre-crisis plans. This deficiency in resources pathed the way for many creative residencies to establish themselves, as being a cheap and temporary solution for vacancy (Bishop & Williams, 2012).

As these young, creative companies are often not the parties with an abundance of financial assets, they need to find accommodation that not only fits their way of working, but is also affordable. However, the overall economy is improving again, and many creative hubs are starting to attract commercial attention. While doing so, the creative companies may be displaced because of the very 'regeneration' they gave rise to, due to increased pricing.

Besides adding to the evidence-base for the socio-economic added value of creative residencies, more insight into the impact of creative hubs could provide better substantiated guidelines for developers and initiators of creative residencies. Objective evidence of the added value could support the initiation and preservation of these residencies, by aiding in the negotiations with owners or the municipality about for instance rent- or sale prices (Berkers, 2016). Moreover, it would provide the logical rationale for creating, preserving and stimulating creative hubs throughout a city, also in more prosperous economic times.

The aim of this research is therefore to propose a methodology to measure if the positive impact of the creative sector on the vibrancy of it's urban area exists, and to what extent. Ultimately, the goal is to recommend approaches to how the results may be used in practice, in order to create a resilient urban area.

1.4. Thesis Outline

In chapter 2, the context of the research problem will be described, after which the conceptual framework will be introduced. In the third chapter, the overall research proposal will be laid out. First of all, the research questions are proposed, after which the the overall research design is presented.

The main body of this report is structured into three different parts. For each of these parts separately the associated research methodologies are explained. In part III, the previous parts are combined into conclusions and recommendations.

In the final part of this report, a personal reflection on the overall graduation process is provided.

2. CONTEXT

2.1. Vacancy in Heritage

The past few years, many demographic, functional and economic changes have occurred (De Jong, 2012). All these changes have caused a shift in the demand of real estate, both in quantity and quality. The built environment does not always meet these rapidly changing needs and demands of users, leading to temporary or structural vacancy. The structural vacancy in the Netherlands mainly involves offices, but many factories, schools, town halls, churches and barracks are vacant as well(Slierings, 2011).

Structural vacancy involves both economic and societal problems. On the one hand, vacancy gives rise to problems with both the sales- and rental prices of the buildings. This originates in the fact that the book value of vacant properties is higher than the market value, which is based on potential rental income (Van de Rakt, 2010). Vacant buildings will therefore face depreciation and cause the owner, developer or investor to suffer a lack of income (Remøy, 2010).

On the other hand, and at least equally important, are the social problems related with structural vacancy. As a building becomes vacant, it will be less and less maintained. This sets in motion a process of decay and causes a further decline in the quality of the building (Plasterk, 2009). In turn, the decline influences the livability of the surrounding area, as the decaying building drags the urban area along (Harmsen et al., 2008). Finally, a reappearing circle can be witnessed in which the vacancy of one building also causes low rental or sales prices for adjacent buildings, which again decreases the image and willingness of people to live in a certain area (Koppels, Remøy and Messlaki, 2011).

2.2. The Rise of Creative Sector

The creative industry can roughly be divided into three sub-sectors; creative business services, arts, and media & entertainment (CBS, 2014). These three sectors together include a wide variety of creative professions, from creative agencies and architects to fashion designers and game developers.

In the Netherlands, it is found that for the period between 1996 and 2007 the growth of employment in the creative sector has increased faster than in other sectors, especially in the creative business services (Poort & Marlet, 2007). Since 2002, the creative industry in the Netherlands has grown three times as fast as other industries.

The shift from a technology led society towards a socially led society has caused smaller organisations to work together in order to combine their strengths, competencies and knowledge (De Man, 2004). Especially the creative sector takes advantage of this so-called network society, as many creative companies are uniting themselves in organisations to stimulate collaboration and innovation.

The importance of collaboration causes a shift from the more common push- and pull factors for workplace accommodation of the office sector, to different factors affecting the location of creative sector companies. More traditional push- and pull factors like car accessibility, location and building image remain important, next to sustainability (Remøy & Van der Voordt, 2014). However, Florida's theory suggests that three completely different factors are of influence on the location of creative agglomerations; the 3T's: Technology, Talent and Tolerance. All of these three components have to be sufficiently present within a city in order to attract and retain creative talent (Florida, 2014).

The research of You & Bie (2017) builds upon Florida's 3T theory, and shows that amenities, social tolerance and openness, and economic incentives all significantly influence the location of creative class agglomerations, even though the relative importance of these determinants differs within the creative class sub-groups and within different time frames. Instead of the three sub-groups used in the Netherlands [Creative Business Service, Art and Media & Entertainment], this research adopts the two sub-groups as defined by Florida; Super Creative Core (SCC), and Creative Professionals (CP). The SCC is defined as the professions that produce new forms or designs that are readily transferable and widely useful - which relates to the Dutch definition of the creative sector as a combination of sectors in which initial creation is central (Florida, 2014; CBS, 2014). The CP fraction is defined as a wide range of knowledge-intensive professions, engaging in any kind of creative problem solving. This second fraction of Florida's creative class undeniable utilises some form of creativity, but within this research the focus will be on the sector defined as creative by the Dutch definition, i.e. the super creative core.

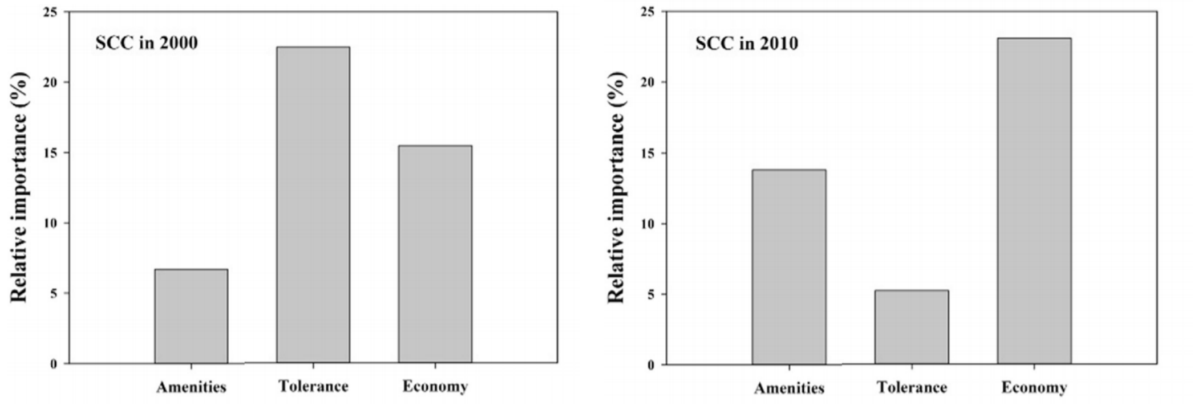


Figure 2.1: Relative importance (in terms of explained variances) of different categories of determinants of creative class agglomeration (You & Bie, 2017).

The three sub-categories within the creative sector also have different specific user preferences when it comes to business space, as extensively researched by Arkenbout (2012). In figure 2.2, an extensive list is provided showing the different user preferences. Overall, companies within the creative sector value the preferences on the use-level most, with the availability of wireless internet connection, meeting spots in the building, security and the possibility to have a monthly contract as most important factors. On the level of location, accessibility and presence of hospitality are the top priorities. Flexibility in terms of office layout and multi-tenancy within the building to facilitate networking, are considered most important on the level of the building (Arkenbout, 2012). Community management has been identified as another important criteria for a well functioning and successful creative residency (van der Hoek, 2016).

2.3. The Emergence of Creative Residencies

The principles of networking and innovation within the creative sector thus entail other working standards than the large organisations of the production economy are used to (Remøy & van der Voordt, 2014). This demand for space differs from the demand of more traditional companies. Flexible, multi-tenant buildings are preferred by the creative sector (Arkenbout, 2012). Besides, when looking at Jane Jacob's statement 'new ideas need old buildings', it could be argued that creative companies desire some kind of historical character in their location (Jacobs, 1961).

Furthermore, since the economic crisis of 2008, many public and private parties have lacked the economic resources to execute pre-crisis plans. To prevent the negative impacts associated with vacancy, temporary initiatives, like temporary leases to facilitate so-called "broedplaatsen", have been utilized as an interim solution (Bishop & Williams, 2012).

A. Creative Business Service	B. Art	C. Media & Entertainment
Location:	**Location:**	**Location:**
1 accessibility by public transport	1 accessibility by bike	1 accessibility by bike
2 accessibility by car	2 accessibility by public transport	2 accessibility by car
3 restaurant & cafe in presence	3 restaurant & cafe in presence	3 restaurant & cafe in presence
4 parking	4 security	4 security
Building:	**Building:**	**Building:**
1 multi tenant building	1 comfort	1 multi tenant building
2 comfort	2 multi tenant building	2 comfort
3 interior representativeness	3 layout flexibility	3 interior representativeness
4 small business units	4 storey height	4 recognizability
Use:	**Use:**	**Use:**
1 internet (wifi)	1 security	1 internet (wifi)
2 meeting places	2 meeting places	2 security
3 security	3 internet (wifi)	3 meeting places
4 month rent contract	4 month rent contract	4 month rent contract

Figure 2.2: User preferences for each sector of the Creative Industry (abbreviated version of Arkenbout, 2012).

Together, the demands from both the creative sector and the need of building owners to prevent vacancy, have proven to provide opportunities to (temporarily) transform industrial heritage into creative residencies (van der Hoek, 2016).

2.4. The Added Value of Creative Hubs

As stated by Richard Florida, job opportunities within the creative sector are a driving force behind economic growth (Florida, 2014; CBS, 2011). Areas where creative companies are located are generally considered as ‘up-and-coming’. The sector is believed to attract and retain businesses, create jobs and revitalise areas. Therefore, the creative sector is nowadays often used as a component of culture-led regeneration, in order to boost local economies and benefit social values. Many urban policies anticipate this impact, but a strong evidence-base to support the added value of the creative sector is missing. Current and past evaluations of such culture-led regeneration policies are often focussed on short-term effects, are biased, or have a purely economic focus.

Significant research into the tangible effects of the presence of the creative sector is still hard to find. In order to fill this scientific gap between theory and practice, there is a need for more knowledge about the socio-economic added value of creative residencies.

2.4.1. Indicators of Added Value

In his research, Evans (2005) gives an extensive overview of the existing tests and measures used to evaluate culture’s contribution to regeneration, related to the associated policy imperatives.

Physical regeneration	Economic regeneration	Social regeneration
Policy imperatives		
Sustainable development	*Competitiveness and growth*	*Social inclusion*
Land use, brownfield sites	Un/Employment, Job quality	Social cohesion
Compact city	Inward investment	Neighbourhood Renewal
Design quality (CABE, 2002)	Regional development	Health and Well-being
Quality of Life and Liveability	Wealth Creation	Identity
Open space and amenity	SMEs/micro-enterprises	Social Capital
Diversity (eco-, landscape)	Innovation and Knowledge	Governance
Mixed-Use/Multi-Use	Skills and Training	Localism/Governance
Heritage conservation	Clusters	Diversity
Access and Mobility	Trade Invisibles (e.g. tourism)	Heritage ('Common')
Town Centre revitalisation	Evening Economy	Citizenship
Tests and measurements		
Quality of Life indicators	Income/spending in an area	Attendance/Participation
Design Quality Indicators	New and retained jobs	Crime rates/fear of crime
Reduced car-use	Employer (re)location	Health, referrals
Re-use of developed land	Public-private leverage/ROI	New community networks
Land/building occupation	Cost benefit analysis	Improved leisure options
Higher densities	Input-Output/Leakage	Lessened social isolation
Reduced vandalism	Additionality and substitution	Reduced truancy and anti-social behaviour
Listed buildings	Willingness to pay for cultural amenities/	Volunteering
Conservation areas	Contingent valuation	Population growth
Public transport/usage	Multipliers—jobs, spending	

Figure 2.3: An overview of the tests and measurements available to evaluate culture's contribution to regeneration (Evans, 2005).

In figure 2.3, a clear distinction is made between physical, economic and social regeneration, relating to added values as defined in the conceptual framework (Adams & Tiesdell, 2012). The tests by which the regeneration is measured in practice, in terms of physical, economic and social change, are mostly quantitative, including more familiar economic and environmental impact indicators, but also more qualitative social indicators (Evans, 2005).

However, the framework above is no universally applicable set of indicators, as valuing in the area of heritage, and cultural impacts in particular, tends to be very context specific. Therefore, a pick and mix approach is required, in order to be appropriate for a particular intervention (ODPM, 2003).

2.4.2. Externalities of the Creative Sector

According to Florida, economic advantages are no longer based on raw materials or on competition for companies. Rather, creativity has replaced these traditional components as the crucial source of economic growth. To be successful in the emerging creative age, he states, cities must develop, attract and retain talented and creative people, in order to generate innovations, develop technology-intensive industries and power economic growth (Florida, 2014). Also other research and many other evaluation reports on regeneration policies, support the view that the creative sector fosters economic growth. For instance, Wedemeier (2015) states that the creative sector indeed positively influences regional growth rates of total employment.

According to the Arts Council England (2014): "There are five key ways that arts and culture can boost local economies: Attracting visitors; creating jobs and developing skills; attracting and retaining businesses revitalising places; and developing talent [...] There is strong evidence that participation in the arts can contribute to community cohesion, reduce social exclusion and isolation, and/or make communities feel safer and stronger. (pp. 7–8)"

However, multiple researchers have criticised the causality assumed by Florida and other theorists. Although few would dispute the role and value that culture has in regeneration in the narrow and, increasingly, in the wider sense, there is much less understanding of the very different effects that particular types of cultural intervention produce in the short and longer term. There is still need for convincing and unbiased evidence, as most available evaluations and impact assessments focus on short term effects, are biased in their origin or just focus on the hit-and-run economic effects (Evans, 2005; Campbell, 2017).

2.4.3. Methods to measure Tangible Effects

There has been little progress over the past decade of evaluation and research, in terms of methods to assess the impacts of culture and creativity (O'Brien, 2013). However, new methods have emerged, in which social media is used to update and complement outdated census socio-economic indicators and in this way arrive at new and improved insights (Vaca Ruiz, 2014; Hristova et al., 2016).

2.5. Conceptual Framework

Based on the evidence found in literature, the presence of creative residencies is expected to work as an incubator for economic and social improvement of urban areas. Building upon this hypothesis, the conceptual model as shown in figure 2.4 takes shape.

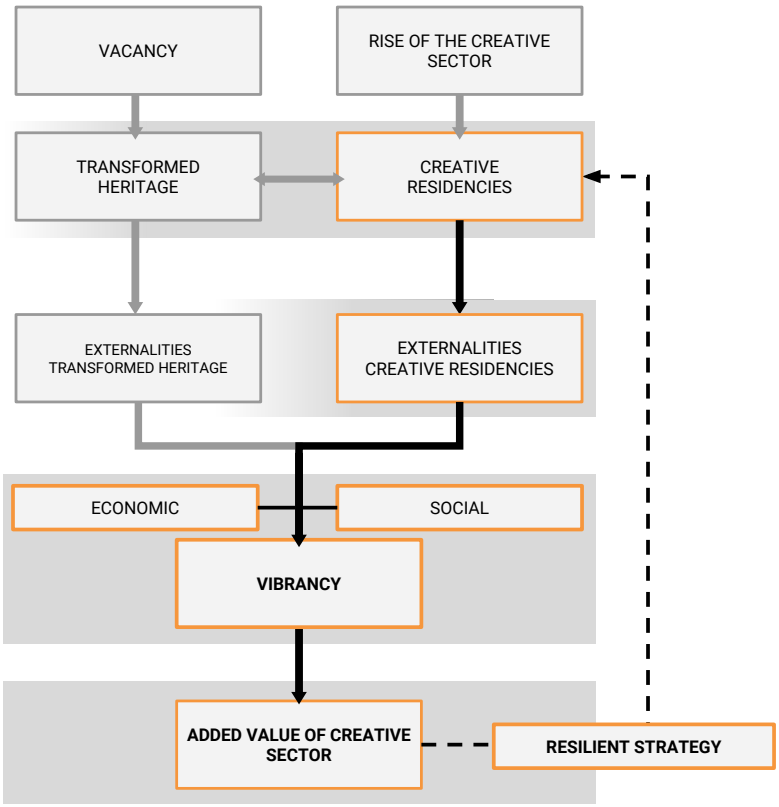


Figure 2.4: Conceptual model (own figure)

As mentioned before, changes in demographic, functional and economic requirements lead to shifts in the demand for real estate (De Jong, 2012). Rapidly changing demands are not always met by the built environment, leading to temporary or structural **vacancy.** Besides being financially disadvantageous, as the building owner will suffer a lack of income, vacancy negatively affects the livability of the surrounding area, as the decaying building drags the urban area along (Remøy, 2010; Harmsen et al., 2008).

To prevent the negative impacts associated with vacancy, many buildings are **transformed** to attract a different target group, either permanently or temporary. By adapting or adding functions, a flow of people is provided, which ensures the livability of the area (Jacobs, 1961). This way, the transformed heritage in itself brings along **positive externalities**, as compared to the base-case scenario in which the building is left vacant (Koppels, Remøy & Messlaki, 2011).

Alongside an increase in vacancy, a significant **rise of the creative sector** has been observed (Florida, 2014; CBS, 2011). In the Netherlands, the creative sector has grown three times as fast as other industries since 2000 (Poort & Marlet, 2007). These often smaller organisations tend to work together in order to combine their strengths, competencies and knowledge, also known as a network society (De Man, 2004).

To facilitate collaboration, creative companies often unite themselves in organisations and prefer multi-tenant buildings (Arkenbout, 2012), also known as **creative residencies**. Although their demand for space differs from that of more traditional companies, there are opportunities to transform industrial heritage into creative residencies (van der Hoek, 2016).

Besides ensuring the positive externalities of occupancy as described above, job opportunities within the creative sector are said to be a driving force behind economic growth, entailing **externalities** of their own (Florida, 2014; CBS, 2011).

Creative residencies are therefore expected to have an **added value** for the surrounding area. Added value can be created in urban environments, when a development increases **economic** viability and deliver **social** and **environmental** benefits (Adams & Tiesdell, 2011).

The presence of creative residencies is however not likely to lead to a significant increase in for instance job opportunities and housing prices directly. It is believed that the creative residencies do lead to an increased **vibrancy** (figure 2.5), especially in areas that might have been deprived, dull, or mono-functional before. Economic spin-offs in combination with entrepreneurship and diversity will eventually lead to social improvement, contributing to aspects like community, social interaction, sense of place and safety (Bruijning, 2016). Ultimately, the added value in social and economic dimensions for the area can increase the value of the building itself (Claassen, Daamen & Zaadnoordijk, 2012).

Although the assumed positive externalities, and ultimately added value, are exploited by the urban area, the creative sector itself still struggles to find suitable and affordable space (Hutton, 2009). Instead of a focus on short-term effects and fast economic growth, a more inclusive, **resilient strategy** is needed in order to sustain this added value.

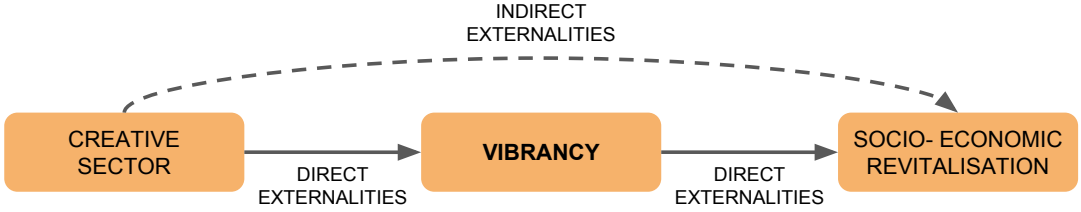


Figure 2.5: Expected indirect and direct externalities of the Creative Sector (own figure)

2.6. Research Scope

This conceptual framework gives a very concise overview of the complex reality surrounding the impact of creative residencies. More in-depth exploration of the research concepts will be given further on in this report. There are however a few concepts that will be omitted in the remaining of this research, as their content is not directly linked to the research aim;

Vacancy

Vacancy in general is a well-known concept in the area of the built environment, with an extensive range of research done on topic. Vacancy in heritage might have provided opportunities to transform and create creative residencies, but the concept in general will not be investigated in this research.

Externalities of Transformed Heritage

The externalities of transformed heritage and the externalities of the function, in this case the creative sector, are both assumed to have a certain added value. These two concepts are thus clearly related, making it very difficult to distinguish the exact impact caused by one or the other, without the availability of a control-group. Therefore it is acknowledged that externalities of transformed heritage exist, also when the transformation does not consider a creative residency, but this research will not examine its separate impacts and instead focus on the externalities of only creative residencies.

Rise of the Creative Sector

The rise and development of the creative sector is a very interesting, but complex social topic. Many studies, among which Hall (2000) and Florida (2014), have elaborated on why and how the creative class has emerged the way it did. Although the rise and increase of the sector is the underlying cause of the emergence of creative residencies, further research into the concept is not essential to answer the proposed research questions.

3. RESEARCH DESIGN

3.1. Research Aim & Questions

The aim of this research is to propose a methodology to measure if the positive impact of the creative sector on the vibrancy of it's urban area exists, and to what extent. This insight into the added value of creative residencies could provide substantiated guidelines for developers and initiators of creative residencies in order to increase their positive impact on the neighborhood. Ultimately, the goal of this research is to recommend approaches as to how the results may be used in practice, in order to create a resilient urban area.

Main Research Question:

"How can the added value of creative residencies for an area's vibrancy be determined and used to design a resilient urban strategy?"

In order to cope with the complexity of this question, three sub questions are formulated:

I. How can the vibrancy of an area be measured?

II. What is the impact of creative residencies on vibrancy?

III. Ultimately, how can the impact of creative residencies be employed in resilient development practices?

3.2. Research Strategy

In order to answer the proposed questions, a mixed-method research strategy is used. This strategy closely relates to the conceptual model and is divided into three separate parts, as illustrated in figure 3.1. As each part of the research design relates to a different subquestion and employs a different methodology, the main body of this report is also structured into three corresponding parts.

Part I

First of all, factor analysis is used to develop a model that represents vibrancy. A theoretical framework is given, both to underpin the indicators used to construct the latent concept vibrancy, and to explain the types of data that are used. Using factor extraction and loading, an answer is given to the first research question.

Part II

Second, quantitative research will be used to find out what the impact on vibrancy of the creative residencies is. This impact assessment will involve both time series analysis and spatial analysis of the vibrancy in four different cases, to find answers to the second research question.

Part III

The findings and results from the previous parts will be combined, in order to give an overview of the conclusions that can be drawn from this research. These conclusions will provide possible approaches as to how the results may be used in practice. Concluding with these recommendations, the ultimate goal is to answer the third proposed question.

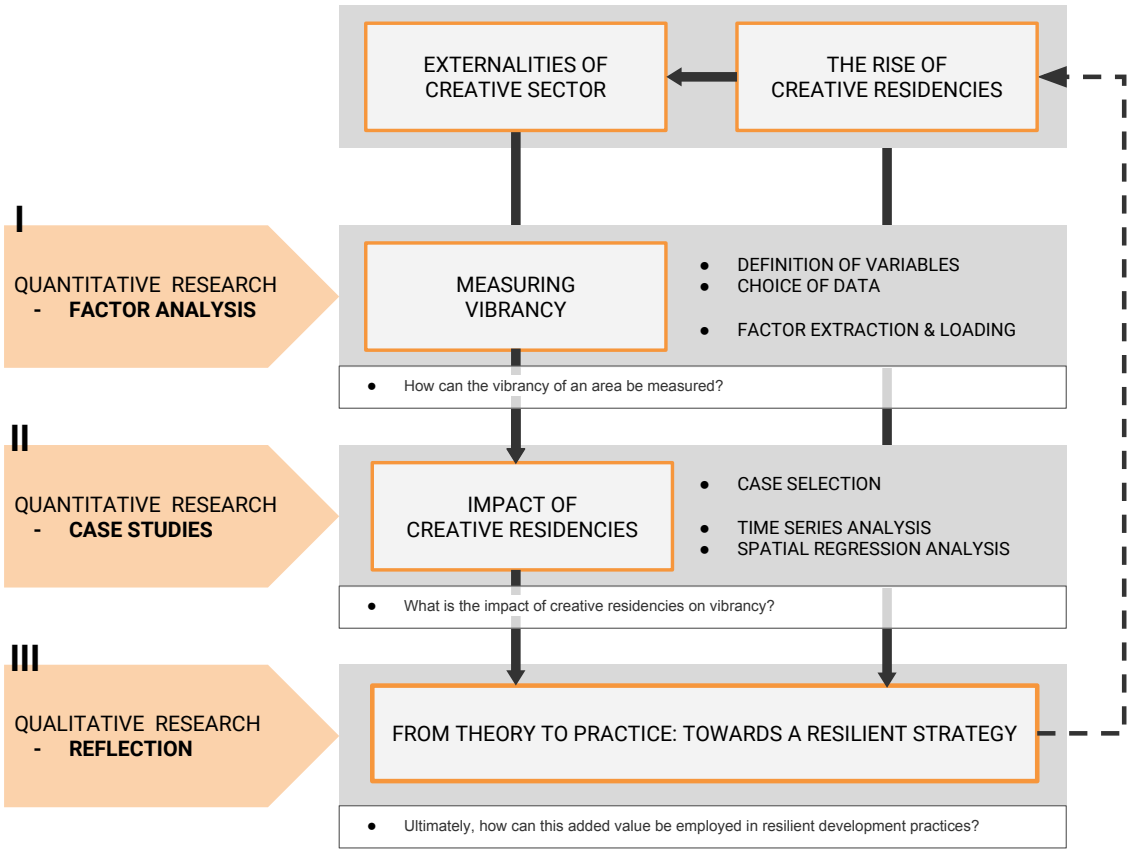


Figure 3.1: Research design (own figure)

A more detailed description of the different methods, including data collection and data analysis, will be given in the associated parts later on in this report.

PART I - MEASURING VIBRANCY

“How can the vibrancy of an area be measured?”

4. OPERATIONALIZATION

Although one can perceive whether an area is vibrant, directly and objectively measuring it is a challenge. Not only is vibrancy prone to subjectivity, it is also very dynamic and includes a multitude of different aspects, ranging from ethnic diversity to the multifunctionality of the built environment.

In order to operationalize the concept of vibrancy, it is therefore essential to explore what specific aspects, or factors, are indicators of vibrancy (chapter 4). Besides, for these different factors, suitable data needs to be found, enabling quantitative analysis (chapter 5). Finally, these quantifiable proxies will be combined into a model, using factor analysis (chapter 6).

4.1. Theoretical Background

4.1.1. Definition of Vibrancy

Many studies into urban planning, urban economy and sociology are focussing on what creates urban life and vitality (De Nadai, et al., 2016). The concept of urban vibrancy, as pioneered by Jane Jacobs in 'The Death and Life of Great American Cities', is a measure of positive activity or energy in a neighborhood. According to Jacobs' theory, it is vibrancy that make an urban place unique and enjoyable to its residents and visitors, despite the challenges of urban living (Humphrey, et al., 2016). Her viewpoint was that safer and more vibrant neighborhoods were those that had many people engaging in activities on the street level at different times of the day (Jacobs, 1961). She suggested that, to promote urban life in large cities, the physical environment should be characterized by diversity at both the district and street level. This diversity, in turn, would be encouraged by four essential conditions:

- Mixed land use
- Small blocks
- Diversity
- Density

Although Jacobs' theory and work was written in 1961, it is one of the most influential pieces in urban planning to date. Testing these conditions empirically, has remained difficult until recently, especially because capturing city life in quantifiable and collectable data is challenging. However, the emergence of new data sources, like mobile phones, sensors and social media, have opened some doors to quantify and test Jacobs' theory. Despite focussing on the 'great american cities' of the 60's, recent research using mobile phone data has verified that Jacob's theory holds for some European cities of today as well (De Nadai, et al., 2016).

4.1.2. Indicators of Vibrancy

Looking more closely at the four essential conditions for diversity, as described above, it is found that they include physical, as well as social and economic aspects (Hospers, 2005; De Nadai, et al., 2016).

- **Mixed Land Use**:

Neighbourhoods must have several functions so that their streets are filled with activity at all times of the day. Monofunctional settings such as business districts and commuter suburbs lack the daily vibrance needed for restaurants, culture and retail trade to flourish.

- **Small Blocks:**

Small blocks of buildings and a finely meshed street pattern, promoting contact opportunities among people. Pedestrians should be able to walk around and turn into another street from time to time.

- **Building Diversity:**

Neighbourhoods need a mix of buildings differing in age and state of upkeep, making it possible to mix high-rent and low-rent tenants. Buildings both old and new have their own economic value for every type of entrepreneur.

- **Density:**

Neighborhoods need a dense concentration of people and buildings, where different types of people –varying from families and entrepreneurs to students and artists – live and work on one spot. With such a variety, there is sufficient critical mass for a varied range of local amenities.

	Physical	Social	Economical
1. Mixed Land Use			Economic functions Day-/Night economy
2. Small Blocks	Building block size Street pattern		
3. Building Diversity	Age of buildings Upkeep of buildings		
4. Density	Building Density	People density People diversity	

Table 4.1: Physical, Social & Economic aspects included in Jacobs' conditions for diversity (own figure)

Building upon this theory, De Nadai et al. identify the importance of 'third places' - locations that are not homes (first places) or places of employment (second places) (De Nadai, et al., 2016). Within the precondition of mixed land use, it is believed that not all places are equal. Third places are able to "foster community and communication among people outside home and work; they are places where people gather primarily to enjoy each others' company" (Oldenburg, 1989). The third places can be classified into four different categories (Jeffres, et al., 2009):

- eating, drinking and talking (e.g. coffee shops, bars, pubs, restaurants, and cafes)
- organized activities contributing to social capital (e.g. places of worship, clubs, organizations, community centers, and senior centers)
- outdoor (e.g. plazas and parks)
- commercial venues (e.g. stores, malls, shopping centers, markets, beauty salons, and barber shops)

In the same way, events are usually meant as a social gathering, being a third place on it's own. Moreover, events are able to show hotspots in terms of people density. When an event is happening, depending on it's scale, a lot of people are expected to be attracted to that certain area. Therefore, a place where a lot of events are organized can automatically be seen as more dense in terms of people, and thus more vibrant.

4.1.3. Conclusions from Theory

Concluding, building upon Jacobs' theory there are four important conditions for a vibrant urban neighbourhood. The physical aspects of Jacobs' conditions, apply more to urban planning of the 'hardware'. However, in this research the impact of a relatively small scale, functional intervention in the built environment (i.e. the presence/creation of a creative residency) on the vibrancy of that district is assessed. The presence of a creative residency is expected to have an impact on socio-economic aspects, rather than having an effect on the physical lay-out of the neighbourhood. Therefore, the focus in constructing a vibrancy model is on the social and economical aspects included in Jacobs' theory, as identified in table 4.1. Besides, the relative importance of third places, and the possibility to track organized events, adds another two indicators to the list. These two fall in between the economy and social categories, as both provide possibilities for socializing, but also entail economic aspects.

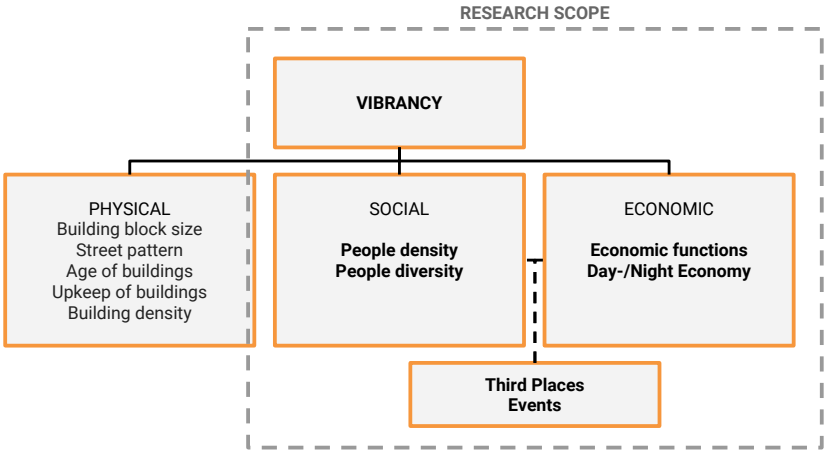


Figure 4.1: Indicators of urban vibrancy (own figure)

4.2. Definition of Variables

As concluded in the previous section, 6 different indicators will be used to measure vibrancy. These six indicators each have a different approach to be able to quantify them:

- **Land Use Mix**

This variable is directly related to the economic functions indicator, as it weighs all the separate functions within an area. To be able to retrieve one single variable for each grid, the Herfindahl index is used, which is defined by the sum of the squares of the functions within a grid. An outcome close to 0 indicates a diverse mix of functions, while an outcome of 1 indicates that the area is dominated by just one function.

$$LUM_{gt} = \sum_{i=1}^{n} \left(\frac{M_{igt}}{M_{ngt}}\right)^2$$

Where:

LUM_{gt} is the land use mix for grid g in year t,

i is one of the specific functions,

n is the total number of functions,

M_{igt} is the total square meters of function i for grid g in year t and

M_{ngt} is the total square meters for all functions n for grid g in year t.

- **Venues**

This variable relates to the Third Places mentioned in the previous paragraph, as it roughly entails the same functions.

The number of venues in grid gin year t is annotated as:

$$Venues_{gt}$$

- **Day-/ Night Economy**

This indicator will be included in the events and people density variables. By distinguishing a [day-time] or [night-time] for these two variables, differentiation is possible in how much of the total events and people in a grid are there during day- or nighttime. This way, the day-/ night economy component can be taken into account in the vibrancy model.

- **People Diversity**

People diversity could entail a multitude of characteristics of both residents and visitors. However, the focus here is kept on the area's residents, as accessing data about the personal characteristics of visitors is an insuperable challenge. Besides, many variables that would preferably be included are not accessible for the small scale employed in this research. More details about the exact data used is provided in the next chapter.

Ultimately, this leaves two interesting diversity measures for people to include in the analysis, i.e. ethnic diversity and diversity in age. For these two, also the Herfindahl index is used to construct a single measure.

$$Ethn\_Div_{gt} = (Ethn_{A,\,gt})^{2} + (Ethn_{WI,gt})^{2} + (Ethn_{NWI,\,gt})^{2}$$

Where:

$Ethn\_Div_{gt}$ is the measure of diversity in ethnicity for grid g in year t,

$Ethn_{A,\,gt}$ is the percentage of autochthonous residents for grid g in year t

$Ethn_{WI,\,gt}$ is the percentage of western immigrant residents for grid g in year t

$Ethn_{NWI,\,gt}$ is the percentage of non-western immigrant residents for grid g in year t

$$Age\_Div_{gt} = [Age_{0-14,\,gt}]^{2} + [Age_{15-24,\,gt}]^{2} + [Age_{25-44,\,gt}]^{2} + [Age_{45-64,\,gt}]^{2} + [Age_{65+,\,gt}]^{2}$$

Where

Age_Div_{gt} is the measure of diversity in ethnicity for grid g in year t,

$Age_{0-14,\,gt}$ is the percentage of residents between 0 and 14 years old for grid g in year t,

$Age_{15-24,\,gt}$ is the percentage of residents between 15 and 24 years for grid g in year t,

etc.

- **Events**

The number of events in grid gin year t is annotated as:

$$Events\_day_{gt}$$
$$Events\_night_{gt}$$

Where Events_day have a starting time before 18:00 PM, and Events_night have a starting time after or equal to 18:00 PM.

- **People Density**

The number of people attending events is used as a proxy of the people attracted to a certain grid. The number of people attracted by events to grid gin year t is annotated as:

$$People\_day_{gt}$$
$$People\_night_{gt}$$

Where People_day are attracted to an event with a starting time before 18:00 PM, and People_ night are attracted to an event with a starting time after or equal to 18:00 PM.

The concept of vibrancy is in fact a latent variable, which means it is not possible to directly observe it. Therefore, vibrancy will be inferred from the variables defined above. To do so, a mathematical model is developed, combining the variables, as shown in equation x. In order to achieve this mathematical model, and decide on the weights of coefficients a to h, factor analysis is used. What this process of factor analysis entails exactly, will be explained in chapter 6.

$$V_{gt} = a \times Venues_{gt} + b \times Events\_Day_{gt} + c \times Events\_Night_{gt} + d \times People\_Day_{gt}$$
$$e \times People\_Night_{gt} + f \times LUM_{gt} + g \times Ethn\_Div_{gt} + h \times Age\_Div_{gt}$$

5. DATA COLLECTION

A second challenge in measuring vibrancy, lies in the availability and collection of data. Traditional data used to address urban issues tends to be static, and aggregated on coarse spatial levels. As mentioned in the previous chapter, the emergence of new data sources provides opportunities to test traditional theories and hypotheses with more sophisticated models.

To define which specific traditional or big data sources to use, it is important to explore which types of sources exist, what their ontological differences are and which challenges and implications they bring (paragraph 5.1.). Based on this theoretical framework, data proxies for the variables, defined in the previous chapter, will be selected (paragraph 5.2.). Finally, the data has to be collected, stored and cleaned (paragraph 5.3.).

5.1. Theoretical Background

5.1.1. Limitations of Traditional Data

Most urban phenomena, including vibrancy, are characterized by rapid changes over time and can be varying on small spatial scales. To address dynamic processes like vibrancy, up-to-date and detailed monitoring of these various components on a fine-grained spatial and temporal scale is of great importance (Marchetti, et al., 2015). By doing so, it would be possible to characterize urban areas and develop urban models to simulate, analyse and, possibly, predict the use of urban space by individuals (Psyllidis, 2016).

However, researchers aiming to achieve this have been operating in data deserts, as much of what we know about cities has been extracted from small-data studies, characterised by data scarcity (Miller, 2010). This is particularly the case in urban development, where many decisions are made on the basis of a rather small amount of expert interviews, surveys and case studies (Petrova, et al., 2016). In the cases where larger datasets are involved, conventional urban data such as national censuses, although reliable and accurate, have limited capacities to give insights into the spatiotemporal dynamics of cities, due to infrequent updates, a generally coarse spatial scale and a limited number of variables (Psyllidis, 2016; Kitchin, 2013).

5.1.2. Big Urban Data

Although there is no agreed definition of big data, according to a survey conducted by Rob Kitchin, big data has the following ontological characteristics (Kitchin, 2014):

- huge in volume, consisting of terabytes or petabytes of data;
- high in velocity, being created in or near real-time;
- diverse in variety, being structured and unstructured in nature, and often temporally and spatially referenced;
- exhaustive in scope, striving to capture entire populations or systems (n = all), or at least much larger sample sizes than would be employed in traditional, small data studies;
- fine-grained in resolution, aiming to be as detailed as possible, and uniquely indexical in identification;
- relational in nature, containing common fields enabling combining different data sets;
- flexible, holding the traits of extensionality (can add new fields easily) and scalability (can expand in size rapidly).

The previously described 'small' datasets, such as national censuses, may very well be very large in volume. However, national censuses lack velocity, variety and flexibility. On the other hand, focused expert interviews might bring a high rate of resolution and variety, but are then only small in volume and lack exhaustivity, relationality and velocity. In fact, most traditional small datasets probably hold some of the traits of big data, but they lack others. Big data on the other hand does contain either all or nearly all of the abovementioned characteristics (Kitchin & Lauriault, 2015).

Strategic solutions for urban issues need accurate and real-time data, in order to solve existing problems and foster city resilience (Márquez & Lev, 2017; Kitchin, Maalsen & McArdle, 2016). To achieve this, emerging sources such as sensors, mobile phones, and social media could be used as proxies for social activity and urban dynamics, in combination with traditional sources of urban data (Psyllidis, 2016). As these big data sources provide a massive pool of inter-relatable datasets, they offer the possibility for a shift in urban studies characterised by data-scarcity, static snapshots and a coarse aggregation to studies that are data-rich, dynamic and entail high resolutions. This way, relatively superficial hypotheses and theories can be converted into more complex and sophisticated simulations and models (Kitchin, 2013).

These big data, and it's sources, can be roughly divided into three groups: directed data, automated data and volunteered data. Directed data is produced by digital, but more traditional, forms of surveillance. Although technology is used to monitor someone or somewhat, a human operator is still involved in this case. An example of directed data is passport control, where passenger details are collected and checked against several databases, and new data is generated such as fingerprints and photographs (Kitchin, 2014).

Automated data on the other hand is produced as an automatic, inherent function of a device or system. Means by which automated data is generated include: smartphones recording and communicating their use, transactions across digital networks, clickstream data, and scanning of so-called 'chips' (such as the OV-chipkaart) (Kitchin, 2013). In the case of volunteered data, data is voluntarily donated by users. This includes the crowdsourcing of data, where users consciously contribute data to a common system, such as OpenStreetMap. But also the posting of comments, uploading of photos and sharing of locations on social media is considered volunteered data (Kitchin & Dodge, 2011).

All these applications and sources of data influence our everyday life, which is increasingly augmented, monitored and regulated by large amounts of data-enabled and data-producing tools and technologies. The huge amounts of information produced by these tools and technologies enable new objective ways of describing and analysing human behaviour and activities. Tracking these activities and behaviours therefore offer a great opportunity to understand social complexity, and thus, urban dynamics (Marchetti, et al., 2015).

While all three forms of data generation, as described in the previous section of this paper, can provide valuable insights into urban dynamics, especially automated data has the ability to offer continuous data regarding the movements of people and materials (Batty et al., 2012). By doing so, automated data offers a source for real-time analysis of urban life and infrastructure, and has the potential to improve the status of various urban structures and systems (Kitchin, 2014).

Although volunteered data, as opposed to automated data, lacks some of the continuity, social media mining does present concrete opportunities to track human behaviour and understand urban complexity (Marchetti, et al., 2015). As social media offer a massive amount of new, unstructured data, often including spatial attributes, they provide an unique source for geographical analysis (Kitchin, 2013). Especially when assessing challenges involving longer time-spans, such as socio-economic issues, social data could offer possibilities to arrive at more data-rich, in-depth insights.

An example, underpinning the novel analysis of urban dynamics using big social data, is the research of Hristova et al. (2016), in which urban social diversity is measured by using interconnected geo-social networks. Through capturing the social diversity of urban locations, by looking at the social network and mobility patterns of the locations' visitors, the distribution of deprivation across neighbourhoods in relation to diversity can be shown (Hristova et al., 2016). Other examples in which so-called LBSN's (location based social networks) are used, include 'Grapevine', a prototype dashboard that aims to identify urban regeneration areas based on the number of events and openings of new venues (Geophy, n.d.) and 'Social-Glass', a web-based platform that integrates large-scale and heterogeneous urban data for application in city planning and decision-making (Psyllidis, Bozzon, Bocconi & Bolivar, 2015).

5.1.3. Challenges & Implications of Big Data

These promises of big data may seem to offer endless possibilities, and essentially give the impression that big data is more valuable for research and business than the more traditional, small data. Indeed, many academics from different fields and disciplines are starting to use big data in their studies, including those in the field of urban dynamics. In some cases this is driven by the idea that big data can speak for itself, is objective and value-free, and does not require contextual or domain-specific knowledge when analysed and interpreted (Kitchin, 2013; Kitchin, et al., 2016). However, the use of big data is subject to significant challenges and implications, relating to it's access, quality, and technical feasibility.

First of all, although some big data is generated by public agencies and may be readily accessible by researchers or the public, much big data is currently produced by private companies. These private companies are under no obligation to freely share their big data, which often is a valuable commodity to them, providing either a resource that generates competitive advantage or being a key product in itself. In some cases, mostly involving volunteered data, a limited amount of privately owned data is made available through API's. However, most of the big data, especially directed and automated data, is not publicly

available in unprocessed forms (Kitchin, 2015). The problem here is that the insights, generated by privately owned and commercially sold big data, will be either limited to the business sector or maybe only accessible to a small group of researchers, whose findings cannot be replicated or validated (Lazer et al., 2009). This challenge of competition and privatisation therefore creates the contradiction that only a few entities are "drowning in the data deluge" (Boyd & Crawford, 2012).

When access can be obtained, it still does not mean the data can be used for every purpose. The suitability for complementing or replacing other, small data, must be assessed. Although big data certainly tends to be more exhaustive, dynamic and granular, it does not provide a perfect, all-seeing view. As with all data, every form of big data uses a certain lens with which reality is perceived. Often, big data is a by-product of another primary function. Therefore, when using big data for a research, it often means re-using data that was not designed or created for that specific purpose (Kitchin & Lauriault, 2015). This could lead to a number of

issues, relating to the data's quality, veracity and lineage.

One key aspect in this regard is the representativeness of the data. Although exhaustive, big data is generally not representative for a whole population, as the data only relates to the people using a certain service. For example, social media offer an enormous pool of data. However, this data only relates to people using these social media, potentially over- or under-representing people from a certain social class or age. Insights retrieved from these social media data will therefore be biased and fail to provide real objective conclusions.

Besides, big data can be full of dirty, gamed and faked data, reflecting badly on it's general accuracy and credibility (Kitchin, 2015). For instance anonymous or fake social media accounts and location spoofing, which refers to intentionally falsifying one's actual locational information, contribute to this (Zhao & Sui, 2017). Also, many datasets are being incomplete and inconsistent, as many systems within which big data is generated are tweaked and

changed over time (Kitchin, 2015). Furthermore, producers of big data are generally reluctant to share how the data was exactly produced and processed. This often leads to insufficient methodological transparency, making it hard to assess what the qualities or fallacies of the big data at hand actually are (Kitchin, 2015).

In contrast, some argue that big data studies do not have to meet the same criteria of data quality, veracity and lineage as other, small data studies. According to these big data advocates, the comprehensive and exhaustive nature of big data removes sampling biases and can therefore compensate for any errors, gaps, inconsistencies or weaknesses in credibility and accuracy (Mayer-Schönberger & Cukier, 2013). However, this view does not account for any bias in the sampling of big data, which, as mentioned above, actually can be the case.

The final challenge in using big data as a resource is related to the technological feasibility regarding transferring, storing, cleaning, checking, and linking big data, and conjoining the data with other datasets (Kitchin, 2015). At the moment there is a lack of user-friendly tools for dealing with big data, making it challenging to work with. Particularly the development of techniques for handling and analysing data sets that consist of massive amounts of observations and are being generated on a dynamic basis, poses a real challenge (Kitchin, 2015).

5.1.4. Conclusions from Theory

It is clear that big data provides many opportunities for a shift from research, traditionally characterised by data-scarcity, static snapshots and a coarse aggregation to studies that are data-rich, dynamic and entail high resolutions. Especially automated data and social media sources offer interesting possibilities, respectively due to it's continuity and data-richness.

However, there are some serious issues involved when using big data in research, relating to it's accessibility and quality, as well as technical challenges. Accessibility might pose a real challenge in cases where the needed data sets are produced by private companies. Consequently most of the big data, especially directed and automated data, is not publicly available in unprocessed forms. When looking at volunteered data, some data is often made available through API. This group of data sources however then present some other issues, regarding the data's quality and veracity. However, according to some big data advocates, the exhaustivity of the big data removes sampling biases and might therefore compensate for any errors, gaps, inconsistencies or weaknesses in credibility and accuracy. Nonetheless, sampling biases do occur, as the data only relates to the people using a certain service.

Therefore, it is of paramount importance that any form of big data is not treated as a objective and value-free source of information. Although big data certainly tends to be more exhaustive, dynamic and granular than traditional data, it should be understood that it can not speak for itself. In contrast, it should be critically assessed, combined with more traditional sources of data, and handled with the required contextual and domain-specific knowledge when analysed and interpreted.

5.2. Data Selection

In order to perform statistical analysis, spatial data is needed. This can include multiple file types, e.g. spreadsheet data, tabulated data or GIS data, as long as the file contains a geographical attribute.

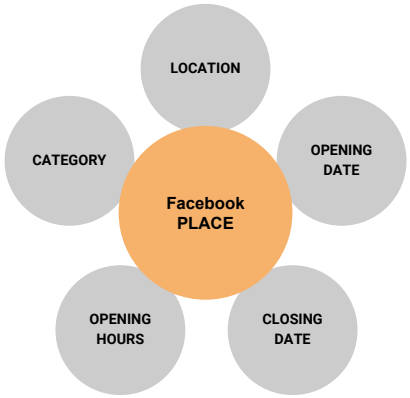
Social media Data

As mentioned in the previous paragraph, this form of volunteered data tends to be biased, as the data only relates to the people and businesses using a certain social media platform. However, it is believed that businesses making use of social media platforms have a higher exposure to the public and therefore contribute more to the vibrancy of an area. Also in terms of visitors, it is believed that the largest chunk of people contributing to an area's vibrancy falls within a certain age range and class that is generally using social media. Therefore, the bias is in this case not expected to distort the results too much.

Integration of different social media sources is preferred in order to enhance the data. However, as different sources do not use any common identifiers, it is hard to filter for actual duplicates in the data, making the integration process very time intensive. This has lead to a focus on Facebook data. Facebook provides both venues- and eventdata. Besides, the Facebook platform is commonly used in the Netherlands for many different types of public events and venues.

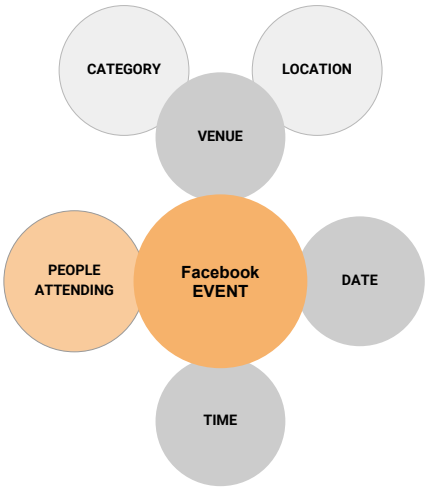
For the ***Venues*** variable, the Facebook places are used. The Facebook places dataset includes the following attributes:

- Location coordinates
- Venue category
- Venue opening date
- Venue closing date (in case of permanent closure)
- Venue opening hours



The ***Events*** variables, including the day- and night time, are build upon the Facebook Events dataset, which contains the following features:

- Event venue
- Venue coordinates
- Venue category
- Event date
- Event start time
- People attending



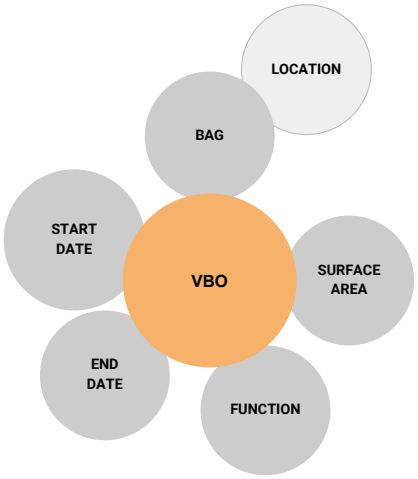
Using the starting times of the events, the day- and night variables can be distinguished. Also, the numbers of people attending the events are utilized as a proxy for the ***People Density*** variable.

Other spatial data

Besides the social media data listed above, also some more traditional data sources will be used:

For the ***Land Use Mix*** variable, the VBO dataset of the BAG is used. The VBO dataset includes accommodations, with attributes for per data entry for:

- surface area
- function of the accommodation
- start- and end dates to which the specific data entry is applicable.
- The dataset can be linked to the BAG Building dataset by address, which in turn gives the geographic coordinates for the specific accommodation.



For the ***People Diversity*** variables, the CBS "Map 100 by 100 meters with statistics" is used. This dataset contains demographic statistics for the Netherlands per 100 by 100 meter square, including:

- CBS 100 by 100 square identifier
- Number of residents per age group
- Percentages of residents for natives, western-immigrants and non-western immigrants.

5.3. Data Collection & Integration

5.3.1. Data Collection

While the BAG and CBS datasets can be downloaded directly, extracting data from social media entails a different process. In general, data from social media platforms can be extracted through an API. API is short for Application Programming Interface, which allows different computer programs and platforms to communicate with each other. Also Facebook has their own API developer tool to extract data and information from the Facebook platform.

The API developer tool offers different approaches to the extraction of data, but within the tool itself it is not possible to search for many places or events at once. To solve this, an Express-based web service was used, in order to get public Facebook places and events by location and distances. However, the Graph API search limits the number of results, independent from the distance used. To deal with this limitation, a grid is created of 1000x1000 meters. All the centroids of the 1332 squares of the grid were taken as geometry points, and subsequently converted into geographic coordinates in PostGIS that can be used as input for the Graph API search. This allows the search to use a radius of just 710 meters per square, keeping the number of results below the limit. Besides, a 'since' clause is added to the script used to retrieve events, as otherwise only future events are retrieved. The value is set to January 1, 2007, converted to Unix Timestamp 1167649200, as before this date Facebook was practically not used in the Netherlands.

The output for both the Places and Events API call is retrieved as 1332 separate JSON files, which are converted and combined into one CSV dataset. These two CSV datasets are then cleaned and filtered for both complete, consistent and inconsistent duplicates. Figure 5.1 and 5.2 show the plotted output of the process described above.

Figure 5.1: The Venues dataset

Figure 5.2: The Events dataset.

5.3.2. Data Limitations

Although especially the Events dataset is able to provide novel insights, especially the Venues dataset contains some critical limitations. Besides a limited amount of inaccurate values, as can be expected when using social media data, a lot of values in the venues data are missing. The attributes for which this is the case are :

- Opening & Closing dates (57% NULL)
- Opening Hours (49% NULL)

As the large amount of absent values leaves little data to analyze, these attributes are excluded from further analysis. Besides, the venue category data has thousands of incorrect, missing or ambiguous values, and has to be excluded as well.

An additional challenge lies in the amount of facebook data that exists per year, as shown in figure 5.3. Facebook has seen a rapid expansion in their user base, leading to an increasing amount of data.This challenge especially concerns the interpretation of the results, as the increasing amount of available data could distort the results to look like an increase in the actual number of events, or even vibrancy.

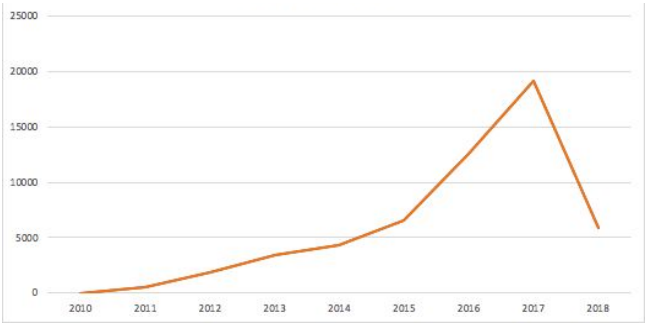


Figure 5.3: Amount of events in data, from 2010 - 2018

Another limitation to the data is the way the CBS data is aggregated. The coverage of the data is not exhaustive, as the CBS only reports demographic statistics when a 100 by 100 meter square does contain at least 5 residents. This is also applicable within the separate attributes, e.g. no data is provided for a certain ethnic subclass in a certain square, when less than 5 residents belong to that group. Besides, the ethnic classes are approximated within quite large ranges, especially within the data prior to 2015. Finally, although the CBS does provide data on income and education, this data is not available at the 100 by 100 meters scale used in this research.

5.3.3. Data Integration

The two individual facebook datasets already give an indication of the hotspots throughout the city. However, as vibrancy is inferred from all the variables combined, all the different datasets need to be integrated into one dataset. To be able to integrate the different datasets with each other, grid referencing is used. A grid of 100 by 100 meter squares is created, in which each single grid contains an unique identifier. The size was chosen for two reasons. First of all, the 100 by 100 meters correspond with the most granular data reported by the CBS. Besides, 100 by 100 meters is already quite granular, as shown in figure 5.4, making further reducing the size of the grids redundant.

All the datasets, with the exception of the CBS data, include a spatial attribute in the form of geographic coordinates. Using these geographic coordinates, the data points are spatially joined with the grid and assigned one of the grid IDs.

As the created grid exactly overlaps the CBS grid, it is also fairly easy to spatially join the CBS data with the new grid. However, using the referencing system used by the CBS data itself is not possible. The CBS only reports data for grids with more than 5 residents, which causes a lot of grids to be non-existent. Using the exact same grid referencing system would therefore disregard a lot of data points of the other datasets.

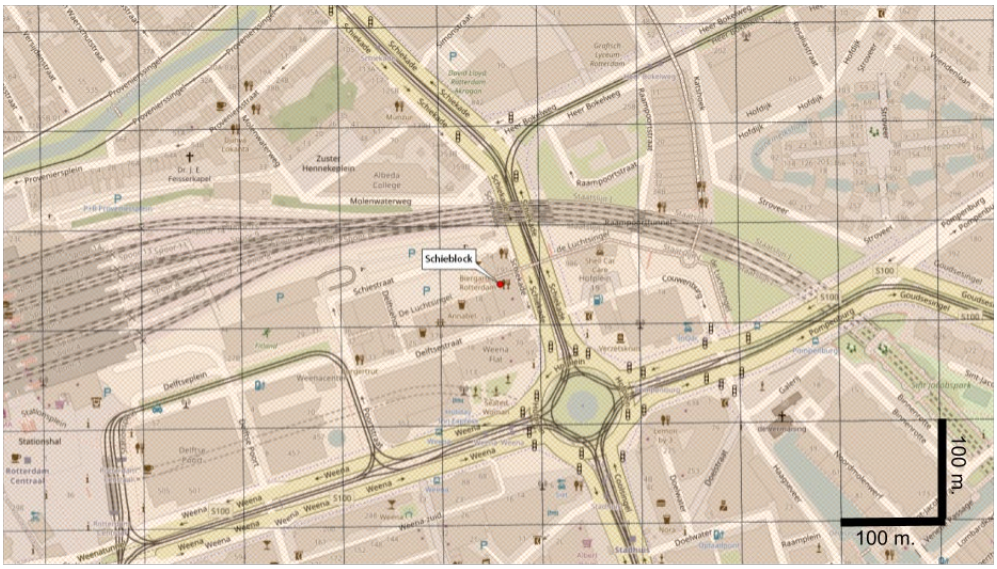


Figure 5.4: Indication of grid referencing size on map

6. FACTOR ANALYSIS

As explained before, the construct of vibrancy is a latent variable and has to be inferred from the variables defined in chapter 4, using factor analysis. Factor analysis is a statistical method used to find joint variability among observed, correlated variables in response to unobserved latent variables. Basically, the factor analysis reduces all the information included in the different variables to fewer factors, that are best able to explain the variability in the observed variables.

6.1. Process

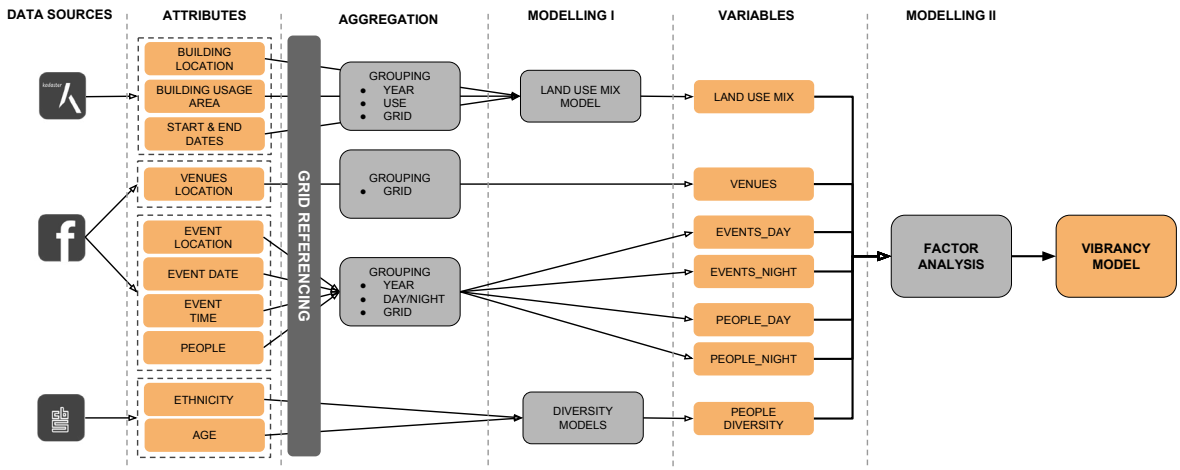


Figure 6.1: Input of the Factor Analysis (own figure)

Figure 6.1 shows the overall data-wrangling process leading up to the factor analysis. There are multiple methods for doing a factor analysis (StackExchange, 2013):

- Principal components analysis (PCA)
- Unweighted Least Squares (ULS)
- Generalized Least Squares (GLS)
- Maximum Likelihood (ML)
- Principal Axis Factoring (PAF)
- Alpha Factoring (AF)
- Image Factoring (IF)

The exact differences between these methods lie in the mathematics behind them, and won't be explained into detail in this report. However, some major differences can be found between PCA, AF & IF, and the other methods.

Principal components analysis (PCA) is in essence not a factor analysis, as it does not pursue to explain correlations, but instead aims to account for multivariate variance as much as possible. It is however a widely used method for factor extraction, especially in the exploratory phase. Alpha Factoring and Image Factoring on the other hand, each have very specific approaches and are only used in special cases.

All the other methods (ULS, GLS, ML and PAF) are referred to as common factor analysis, and can indeed be seen as substitutes for each other. In most cases, they will generate quite similar outputs. They can all be described as linear, continuous latent models. This implies that the data should be linear and continuous, and that for instance categorical or binary data should not be analyzed using these methods. As in this research all the variables are continuous variables, these four methods are used. The results of the different methods are compared, both statistically and spatially on a map, to find any big differences in outcome. The method delivering the best fit and most interpretable results, is then chosen to extract the factors and provide the coefficients for the vibrancy model.

Factor analysis is not usually used in combination with slices of time. In this research however, one of the main elements is tracking changes in vibrancy over time. To do so, the initial vibrancy model is built upon the 2017 data, as this year contains the most data points. Using the same model, and thus the same factor loadings, the values applicable to other years can be used to arrive at the vibrancy scores over time.

Correlation Matrix[a]

		#Venues	#E/Day/2017	#E/Night/2017	#P/Day/2017	#P/Night/2017	DIV_LUM
Correlation	#Venues	1.000	.625	.366	.283	.200	-.195
	#E/Day/2017	.625	1.000	.527	.410	.253	-.088
	#E/Night/2017	.366	.527	1.000	.251	.602	-.088
	#P/Day/2017	.283	.410	.251	1.000	.551	-.025
	#P/Night/2017	.200	.253	.602	.551	1.000	-.031
	DIV_LUM	-.195	-.088	-.088	-.025	-.031	1.000
Sig. (1-tailed)	#Venues		.000	.000	.000	.000	.000
	#E/Day/2017	.000		.000	.000	.000	.000
	#E/Night/2017	.000	.000		.000	.000	.000
	#P/Day/2017	.000	.000	.000		.000	.000
	#P/Night/2017	.000	.000	.000	.000		.000
	DIV_LUM	.000	.000	.000	.000	.000	

a. Determinant = .145

Figure 6.2: Correlation matrix for all variables

First, all variables are included in the exploratory factor analysis, to assess the correlations between the different variables, as shown in figure 6.2. An important rule of thumb taken into consideration here is that any variables with any correlations above 0.9 or most correlations below 0.1 should be excluded. Correlations above 0.9 indicate that two variables might measure the same thing, while very low correlations indicate that real linkages between variables are lacking.

While no correlations above 0.9 can be found, low correlations are discovered among the diversity measures. Especially the people diversity measures (DIV_AGE & DIV_ETHN) have low correlations with almost every other variable, except each other. Also the land use mix (DIV_LUM) has many low correlations, but less so than the other two.

The different factoring methodologies described above are therefore executed for three different sets of variables:

- all variables
- all variables without DIV_ETHN and DIV_AGE
- all variables without DIV_ETHN, DIV_AGE and DIV_LUM (which essentially leaves only the data extracted from Facebook)

As expected, the DIV_ETHN and DIV_AGE variables do not improve the model and are therefore omitted. This does not mean that the diversity of people is not of importance when assessing vibrancy. Rather, the exact aspects taken, i.e. ethnicity and age, and the small scale on which the data is aggregated might contribute to the low correlations. Aggregation of people diversity measures on a larger scale, e.g. neighborhood scale, and a focus on other aspects attributing to people diversity like lifestyles, income and education, might be a valuable addition in further research.

6.2. Factor Extraction

Comparing all the results of the different options in methods and sets of variables, especially the interpretability of the outcomes are taken into account. The best interpretable and explainable result is found when extracting 1 factor using the unweighted least squares method. The complete output of this method can be found in Appendix I.

The factor loadings, i.e. the weights of the different variables onto the factor, are shown in figure 6.3. A negative value for the DIV_LUM variable here makes sense, as a higher value for this variable means a less diverse mix of land uses, and therefore a lower expected vibrancy. The other variables are all positive, and have comparable weights in making up the vibrancy score.

Factor Score Coefficient Matrix

	Factor 1
#Venues	.166
#E/Day/2017	.355
#E/Night/2017	.282
#P/Day/2017	.169
#P/Night/2017	.219
DIV_LUM	-.034

Extraction Method: Unweighted Least Squares.
Factor Scores Method: Regression.

Figure 6.3:Factor Score Coefficients

Reproduced Correlations

		#Venues	#E/Day/2017	#E/Night/2017	#P/Day/2017	#P/Night/2017	DIV_LUM
Reproduced Correlation	#Venues	.348[a]	.434	.417	.327	.358	-.079
	#E/Day/2017	.434	.541[a]	.521	.408	.446	-.098
	#E/Night/2017	.417	.521	.501[a]	.392	.429	-.094
	#P/Day/2017	.327	.408	.392	.307[a]	.336	-.074
	#P/Night/2017	.358	.446	.429	.336	.368[a]	-.081
	DIV_LUM	-.079	-.098	-.094	-.074	-.081	.018[a]
Residual[b]	#Venues		.191	-.051	-.043	-.158	-.116
	#E/Day/2017	.191		.007	.002	-.193	.010
	#E/Night/2017	-.051	.007		-.141	.172	.006
	#P/Day/2017	-.043	.002	-.141		.215	.048
	#P/Night/2017	-.158	-.193	.172	.215		.050
	DIV_LUM	-.116	.010	.006	.048	.050	

Extraction Method: Unweighted Least Squares.

a. Reproduced communalities

b. Residuals are computed between observed and reproduced correlations. There are 8 (53.0%) nonredundant residuals with absolute values greater than 0.05.

Figure 6.4: Reproduced correlations

When looking at figure 6.4. 53% of the nonredundant residuals have an absolute value above 0.05, where at least less than 50% is preferred. However, the data has a lot of outliers, as it is and will be with user-generated data. Even though this 53% would preferably lower, this model is easy to interpret properly, and therefore an acceptable fit.

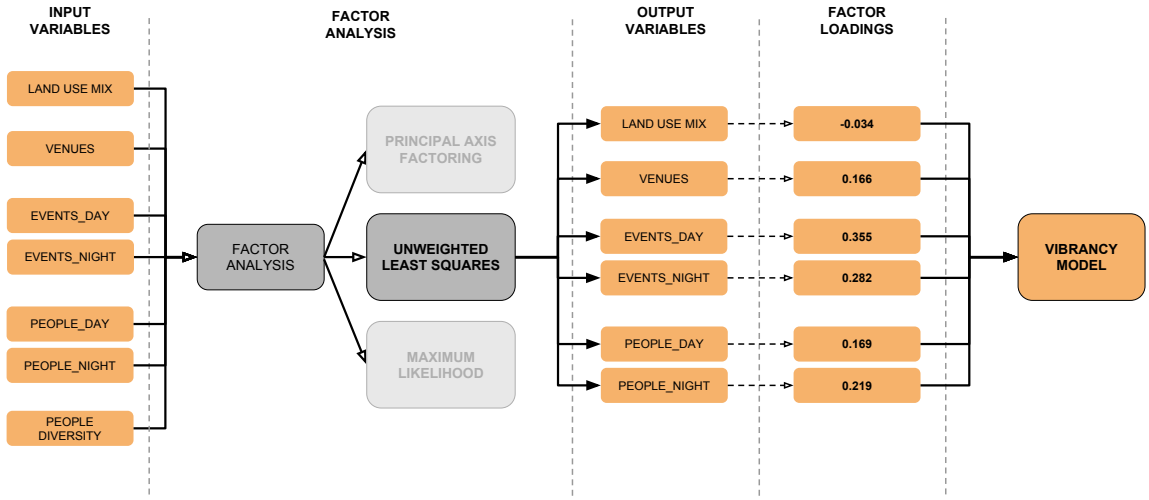


Figure 6.5: Output of the Factor Analysis (own figure)

6.3. Vibrancy Model

With the outcomes of the factor analysis, it is possible to construct the vibrancy model, as shown below. The model calculates a vibrancy score Vfor grid gin year t, by multiplying the standardized values of each variable by it's factor loadings. The model uses standardization of variables using the mean and standard deviation of the total dataset, i.e. for the data of the entire city of Rotterdam for the years 2011-2017 (c).

(1)

$$V_{gt} = 0.166 \times \frac{Venues_{gt} - \overline{Venues_c}}{SD[Venues_c]} + 0.355 \times \frac{Events\_Day_{gt} - \overline{Events\_Day_c}}{SD[Events\_Day_c]} + 0.282 \times \frac{Events\_Night_{gt} - \overline{Events\_Night_c}}{SD[Events\_Night_c]}$$
$$+ 0.169 \times \frac{People\_Day_{gt} - \overline{People\_Day_c}}{SD[People\_Day_c]} + 0.219 \times \frac{People\_Night_{gt} - \overline{People\_Night_c}}{SD[People\_Night_c]} + (-0.034) \times \frac{LUM_{gt} - \overline{LUM_c}}{SD[LUM_c]}$$

With this model an overall increase or decrease over time can be observed. However, to assess the growth in a certain grid relative to the level of the vibrancy scores in that grid, a second function is used, as shown below. With this second formula, the relative percentage change can be used to compare the level of vibrancy in two years, while taking into account the level of vibrancy in that area.

(2)

$$\Delta V_{gt} = \frac{V_{gt} - V_{gt-1}}{V_{gt-1}}$$

6.4. Results

With the constructed model, the vibrancy scores for every grid can be calculated, and subsequently be plotted on the map of Rotterdam to visualize their spatial layout. In the following figures these results are shown.

The vibrancy scores of all grids are clustered into groups, after which each group is given a colour, ranging from light yellow (low vibrancy scores) to dark red (high vibrancy scores). To optimize the clusters, a Jenks natural breaks classification method is used, which reduces variance within groups and maximizes the variance between groups. The group containing vibrancy scores below 0 has been made transparent in the maps, but data and vibrancy scores are existing for these grids.

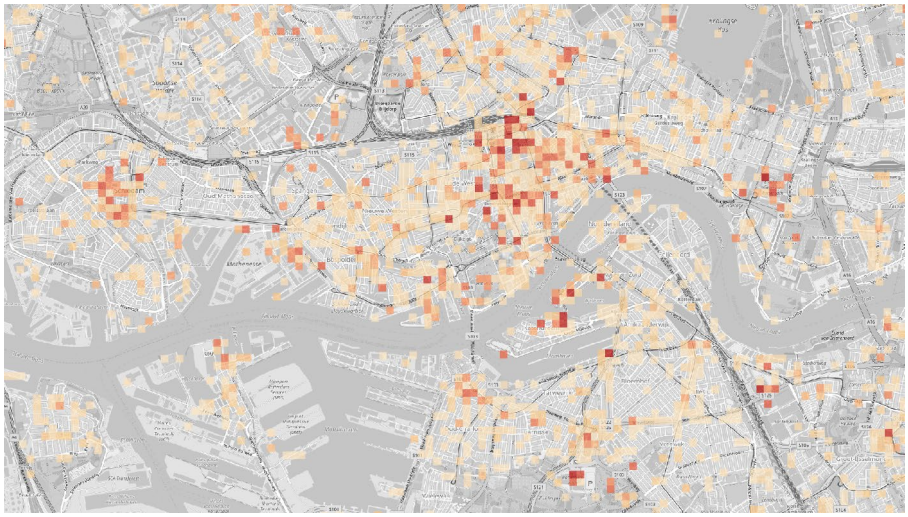


Figure 6.6: Vibrancy scores for the city of Rotterdam in 2017.

Figures 6.7 - 6.12. illustrate the changes in vibrancy scores over years 2011 - 2016 for the city of Rotterdam.

Figure 6.7: Vibrancy scores 2016

Figure 6.8: Vibrancy scores 2015

Figure 6.9: Vibrancy scores 2014

Figure 6.10: Vibrancy scores 2013

Figure 6.11: Vibrancy scores 2012

Figure 6.12: Vibrancy scores 2011

When looking at the figures above, an overall increase of the city's vibrancy scores can be witnessed over the years 2011 until 2017. This large overall increase in city average, as shown in figure 6.13, shows a distorted view on reality, as the increase can be partially attributed to the increase in the use of facebook. When assessing and interpreting the results, this skewness of the data should be kept in mind.

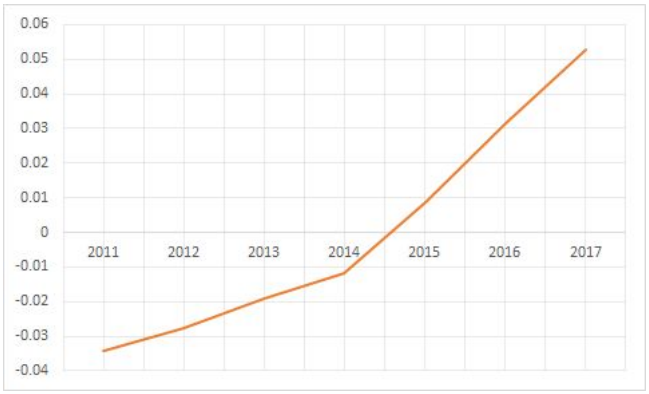


Figure 6.19: Increase in average vibrancy score of Rotterdam for the period of 2011 - 2017 (own figure).

PART II - THE IMPACT OF CREATIVE RESIDENCIES

“What is the impact of creative residencies on vibrancy?”

7. OPERATIONALIZATION

As introduced in the beginning of this report, the presence of creative residencies is expected to work as an incubator for economic and social improvement of the urban area. It is believed that the creative residencies lead to an increased vibrancy. Economic spin-offs in combination with entrepreneurship and diversity will eventually lead to social improvement, contributing to aspects like community, social interaction, sense of place and safety (Bruijning, 2016).

In order to assess whether this hypothesis holds true, the impact on vibrancy of four different creative residencies in Rotterdam is assessed. Based on the vibrancy model constructed in the previous part, descriptive statistics is used to explain the results and relate them to identifying characteristics of the cases. In the following paragraphs, the criteria for the cases will be introduced, and the methodology for assessing their impact will be explained.

7.1. Case Selection

The cases are chosen on the basis of the following criteria:

1. Different cities in the Randstad [Amsterdam, Rotterdam, The Hague]
2. Location within urban environment
3. Availability of data and information
4. Variety of longer established projects and projects that are relatively new
5. Adoption of community management

Although interesting, the differences in demographics, economic circumstances and overall image in different cities make it challenging to analyse multiple cities within the research scope. The initial focus is on the Randstad, which is known for it's overall density and agglomeration economy. Even though different agglomeration economies are present in the Randstad and positively affect business start-ups, these externalities are spread across the whole Randstad instead of being confined to a particular agglomeration (Dijk, Meer & Borg, 2013). However, when dealing with vibrancy, some important dissimilarities are expected between the three cities:

- Amsterdam in general has been booming the last years. This will make it difficult to distinguish the impact of creative residencies from the general boom in vibrancy.
- In The Hague only two cases have been identified, that are located within the same neighborhood. This makes it difficult to pull apart the two cases, leaving only one case that is located in this city.
- Rotterdam on the other hand, has seen a steady increase in economic growth over the last years. Not too long ago, real estate prices were relatively low when compared to the other two cities. Also, the urban fabric of Rotterdam is more diverse, in terms of building age, upkeep, and density.

Because of this, the scope is reduced to the city of Rotterdam. Within this city, four cases are selected that meet the criteria:

- Schiekadeblok, Rotterdam
- Creative Factory, Rotterdam
- Keilewerf, Rotterdam
- Het Industriegebouw, Rotterdam

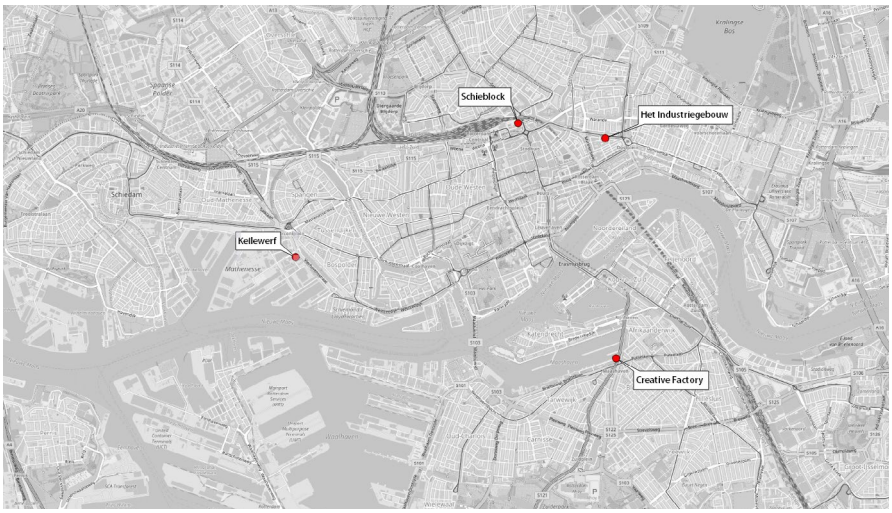


Figure 7.1: Location of the cases

Although some of these cases are located within a more urbanized and densely populated area than others, all of them are located within the city boundaries. It is of importance to select cases that are located in an urbanized area in order to measure the effects of the creative residency on it's surroundings.

The selected cases also differ in age, with opening dates ranging from 2002 till 2017. Tracking changes from the opening dates of the older residencies is not possible, as hardly any data is available for the years prior to 2011. However, when a residency is longer established, it has had more time to affect the urban area surrounding it, which could lead to more clear externalities in later years, with a greater span width. On the other hand, newer residencies might have the benefit of a higher exposure and more anticipation, leading to a quick response.

Although the four cases differ significantly in location, size, age and character, the one common factor is that they all have some form of community management. Community management entails the internal management of the residency, in order to improve the productivity of the companies located in it, through an optimal combination and use of each other's services. Community management has been identified as an important criteria for a well functioning and successful creative residency (van der Hoek, 2016).

In the following chapter, for each case an extensive description will be given, including:

- Physical context
- Socio-economic context
- Residency characteristics

7.2. Impact Assessment

SPATIAL ANALYSIS

For each grid, vibrancy scores are calculated using the vibrancy model constructed in part I of this report. Subsequently a closer look will be taken into the different cases, at a 1:10.000 and 1:5.000 scale. Important aspects to examine are:

- Is the creative residency located in a vibrant cluster?
- Is the cluster large and spread-out or small and concentrated?
- Is there a strong link with the surroundings, or does the vibrant cluster seem isolated?

TIME SERIES ANALYSIS

For each grid, and for each year in the period from 2011 until 2017, vibrancy scores are calculated using the vibrancy model constructed in part I of this report. As a result of the differentiation between the two different formula described in paragraph 6.3., it is possible to assess both the levels of vibrancy in an area (model 1), and the relative percentage change in vibrancy scores (model 2).

For each case, the outcomes of both models are plotted into graphs, showing the changes in vibrancy. This is done for the 100 by 100 meter grid the residency is located in (first belt), but also the grids adjacent to this grid (second belt), and the grids adjacent to those (third belt) are plotted into the graphs. In case of strong physical boundaries these belts are adjusted in order to avoid skewing the results. The exact gridID used to make up the belts for each case can be found in Appendix II.

The different belts of areas surrounding the creative residencies are used to assess whether the changes in vibrancy can also be observed in a wider area, indicating more wide-spread externalities, and thus more added value for the area. Important questions to answer when examining the time-series are therefore:

- Is there a significant increase in vibrancy after the opening of the creative residency?
- Are increases in vibrancy mostly observed in the first degree area, or can the same pattern be observed in the second and third degree areas?

CROSS-CASE COMPARISON

Ultimately, the outcomes of the analyses of the separate cases will be compared. Furthermore, the results will be related to the different characteristics of the cases, like the location within the city, the size, the connection with hospitality, etc. By doing so, the aim is to identify important aspects of creative residencies, that may have been of influence on the different outcomes of the vibrancy model.

8. RESULTS

In this chapter the results for each of the cases is provided. For each case, a qualitative description is given, entailing the identifying characteristics and development process of the case. Next, descriptive statistics is used to relate the results of both the spatial and time series analysis to the characteristics of the case.

8.1. Schieblock

8.1.1. Case Description

LOCATION	Rotterdam Central District
OPENING	2002 | Anti-squatting 2009 | Lease
INITIATOR	CODUM & ZUS
GFA	12.000 m2.
COMPANIES	85
FUNCTIONS	Flex workplaces, Office space, Event space, Hospitality, Roof Garden

INTRODUCTION

Since 2002 the Schieblock is occupied by architectural firm ZUS on the basis of an anti-squatting agreement. Real-estate developer LSI buys the property and grounds, and plans to demolish the building to make room for it's building plans. Initiated by the municipality, the plan is to make the Rotterdam Central District the new flagship of the city, with international allure (Rijnaard, 2018). However, when the economic crisis hits in 2009, LSI finds itself in heavy waters.Together with CODUM, ZUS builds a plan for temporary use of the building in the period awaiting realisation of LSI's plans. Their plans are approved for an initial period of 5 years (De Bruijn, 2014).

Everyone, including the municipality and LSI, is positive about the development surrounding the Schieblock. In 2014, the 5-year deal between LSI and ZUS ends. During a debate calling for preservation of the Schieblock, it becomes clear that owner LSI wants to leave the building as it is for the time being. In the new-build plans for the Schiekadeblok, the Schieblock will be developed last, which means it could take as much as 10 or 20 years until some actual demolishing on the Schieblock would happen (De Bruijn, 2014).

In 2017 the municipality develops a new plan for the area, taking into consideration the existing buildings and tenants of the area. The Schieblock and a part of the wider Schiekadeblok will be preserved and integrated into the new developments. However, in 2018 the debate on what to do with the area arises again, due to shifts in municipal politics. Some parties believe that with the economy on the rise again, the old building should make room for more lucrative developments. Others feel that, although the Schieblock has the economic crisis to thank for it's existence, today it is a creative hotspot, attracting international attention, and thus worth preserving. Due to this factionalism, the creative residency's future remains uncertain for now (Rijnaard, 2018).

PHYSICAL CONTEXT

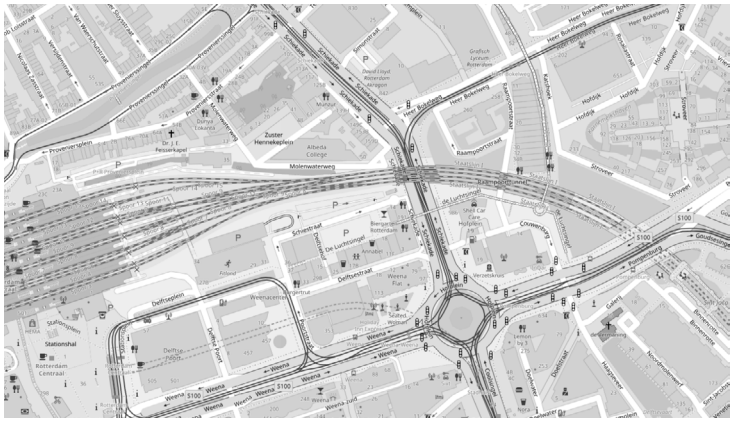


Figure 8.1: Location of Schieblock

The Schieblock is located in the Rotterdam Central District, close to the city centre and Rotterdam central station, from where it can be reached within 10 minutes by foot. The Rotterdam Central District is characterised by a high density and fairly new, large-scale office buildings and some residential towers. A large part of the area was not developed until the 80's, but now the area is home to the some of the tallest high-rise buildings of Rotterdam (Gemeente Rotterdam, 2018). In contrast to the rest of the district, the Schieblock building is located within a city block that encompasses much older buildings, many of which were built in the post WWII period (Hoefnagels, 2018). This city block is enclosed by the streets Schiekade, Delftsestraat and Delftseplein and train tracks on the north side. The train tracks and busy Schiekade induce significant physical boundaries for the Schieblock's location.

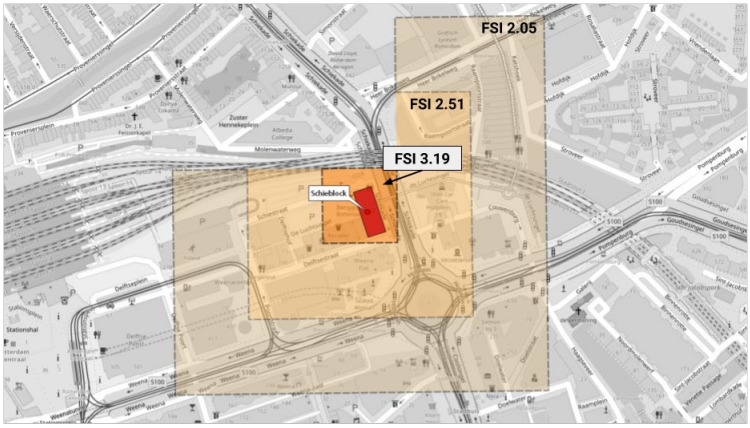


Figure 8.2: Density, as indicated by FSI, surrounding the Schieblock

SOCIO-ECONOMIC CONTEXT

With the renewed Rotterdam Central Station the Central District is one of the major 'ports of Rotterdam'. Every day, thousands of people are flowing into the city through this district. Over 35% of the floorspace in the area office space, with over 11.000 people working here. In addition, close to 1.000 people live in the entire district, partially in the residential towers near the Schieblock. These residents are mostly singles or couples without children (Gemeente Rotterdam, 2018).

Although being older, and having a very different character than the rest of the district, the city block of the Schieblock in it's entirety has shown a multitude of interesting developments the last two decades. Especially hospitality and art venues are popping up in and around this city block.

Thanks to the Biergarten, the previously grim parking place behind the Schieblock has been transformed into one of the most popular places for outside beers in Rotterdam (Van Noord, 2017). Next to the Biergarten, the Schieblock itself hosts club BAR on the ground floor, which opened it's doors in 2013. Club PERRON was located in a vacant building on the other side of the parking lot from 2011, but had to close it's doors in 2014. The premise was supposed to be demolished to make place for a hotel and offices in 2015, but as of today the building is still standing. In 2015, PERRON's owner opened music venue Annabel, in a different vacant premise bordering the parking. In the basement of Annabel, club Transport is located. The Delftseplein-side of the block is home to among others arts centre Roodkapje, restaurant the Burgertrut and a salsa club (Griffioen, 2014; Het Schieblock, 2013; Maessen, 2015).

RESIDENCY CHARACTERISTICS

The Schieblock is located in a 12.000 m2 office building. The monolith on itself is not very fascinating, and is a typical example of the unappealing reconstruction architecture (Hoefnagels, 2018). Nowadays however, the building accommodates around 80 companies spread out over six floors. These businesses range from architectural, design and marketing companies, to event planners and creative individuals. Besides the six floors, the roof of the Schieblock is home to an agricultural garden and a restaurant, while the ground floor hosts club BAR, culture-guides Urban Guides and OMI, culinary business MESS and creative workshop GROOS (Schieblock, n.d.).

LUCHTSINGEL & 'OP HET DAK'

In 2012 the first phase of the Luchtsingel was opened, an initiative from ZUS, with the purpose to create a connection between Rotterdam Central District and Rotterdam Noord. This pedestrian bridge passes right through the Schieblock, and connects it with the roof of the old Hofplein station on the other side of the train tracks. By doing so, the Luchtsingel defies the physical boundaries imposed by the Schieblock's location and creates a direct link with the hospitality businesses located in the Hofplein station. An important element included in the Luchtsingel project has been the development of agricultural garden 'Op Het Dak' on the rooftop of the Schieblock, which was also completed in 2012 (Top010.nl, 2011). Being an urban garden with a view over the city, Op Het Dak serves as an unique location for a restaurant and coffee bar (Op Het Dak, n.d.). The outdoor party given to commemorate the opening of the first phase of this Luchtsingel would be the forerunner for the current Biergarten (Van Noord, 2017).

The semi-public spaces of the ground floor, the roof and the gap in the middle of the building created by the Luchtsingel, are open to non-residents, stimulating interaction between the city and the Schieblock (Schieblock n.d.).

8.1.2. Impact Assessment

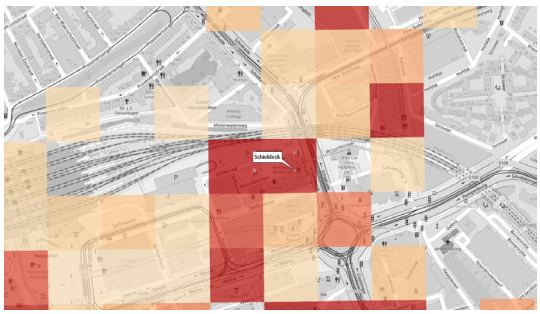


Figure 8.3 & 8.4: Heatmaps with vibrancy scores, Schieblock, 1:5.000 and 1:10.000 respectively.

IMPACT - SPATIAL

The Schieblock is shown to be located in a very vibrant cluster, as the red color in figures 8.3 and 8.4 indicates. This cluster is not just containing the Schieblock itself, but also covers the whole Schiekadeblok all the way to the Weena street.

Zooming out further, the area overall tends to be quite vibrant, but some dark-red clusters can still be distinguished. The bigger clusters among these include the area surrounding Stadhuisplein and Schouwburg- plein. Smaller ones can be found at the Stationsplein in front of Rotterdam Central Station, Noordplein and the old Hofplein Station.

Despite the physical boundary present due to the train tracks, also the old Hofplein station is performing well in terms of vibrancy. Although it is difficult to objectively establish causality between the high vibrancies surrounding the Schieblock and Hofplein station, the results support the importance of the Luchtsingel, which is connecting these two vibrant spots physically.

Taking into account the location of the Schieblock, it is not surprising that other vibrant clusters can be identified in it's surroundings. Close to the city centre and Rotterdam Central Station, a completely isolated vibrant cluster would be unexpected.

IMPACT - TIME

Although figure 8.5 shows an overall positive trendline in terms of absolute vibrancy scores, figure 8.6 shows clearly that the relative growth of these scores is varying throughout the years. The exception is a large relative increase between 2012 and 2013, which can be attributed to the new developments of the Luchtsingel, Dakakker and Biergarten. Subsequent years however show less severe increases, with figure 8.5 even showing a declining line for the past two years, indicating a decreasing vibrancy in more absolute terms as well.

The second and third belts surrounding the Schieblock show comparable trends, may it be at a lower level of vibrancy. This indicates that the second and third belts are indeed influenced by the changes in the first belt.

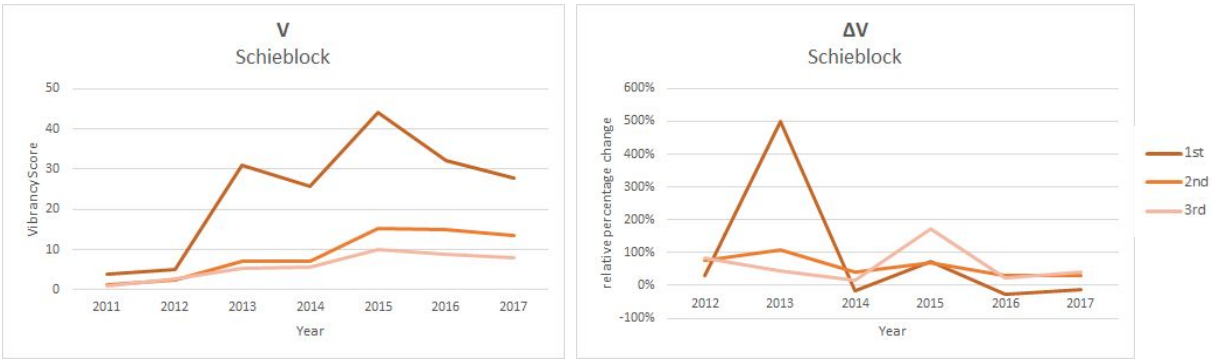


Figure 8.5 & 8.6: Vibrancy scores & relative percentage change for the 1st, 2nd and 3rd belts of the Schieblock.

The Schieblock itself has already been occupied as a creative residency since 2002. Due to a lack of data for the early years of development, it is hard to define whether any major increases in vibrancy have taken place in the period from 2002 until 2011. As the level of vibrancy in 2011 is already significantly higher for this area than the city's average, it is possible that a significant increase has happened in the years before 2011.

Considering the positive public opinion of the Schieblock, the overall decreasing vibrancy is surprising. The results show some large fluctuations in the different slices of time, which could be a result of an uncertain future, and the political debate surrounding the Schieblock.

8.2. Creative Factory

8.2.1. Case Description

LOCATION	Tarwewijk
OPENING	2008
INITIATOR	Municipality of Rotterdam
GFA	2.500 m2.
COMPANIES	25
FUNCTIONS	Event space, Flex workplaces, Office space, Presentation space, Meeting rooms

INTRODUCTION

Since 2008, the Creative Factory is located in an old grain silo bordering the Maas, in the same building as event location the Maassilo. After an extensive transformation, the Maassilo opened it's doors in 2004. From the opening until the end of 2006 the Maassilo was the home of dance club Now&Wow. In 2007 Now&Wow decided to relocate to another location and the Maassilo continued as an independent event location. Amongst others, the location is used for corporate events, seminars, concerts and dance parties. Together with Factory 010 and RAAF, which are part of the building as well, the Maassilo features 15 different rentable spaces in total (Creative Factory, n.d.).

PHYSICAL CONTEXT

The Maassilo building, and thus the Creative Factory, is located on the border of residential areas Tarwewijk in district Charlois and Bloemhof in district Feijenoord. Both areas were developed at the beginning of the 20th century, in order to accommodate the workers of the rapidly growing harbour. The areas are characterised by many porch houses, both in the social- and private housing market (Gemeente Rotterdam, 2018).

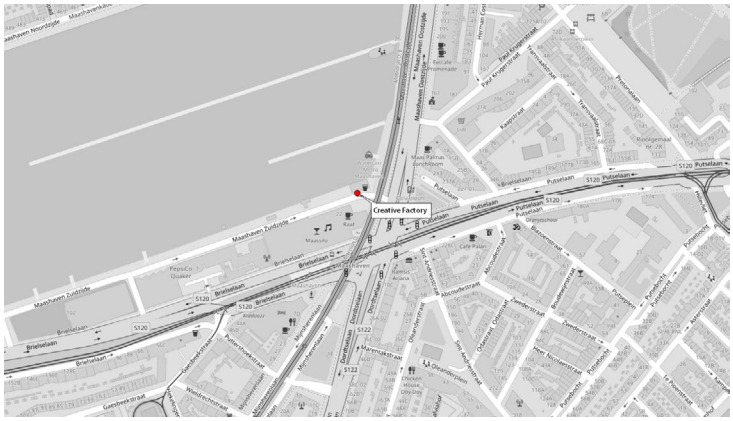


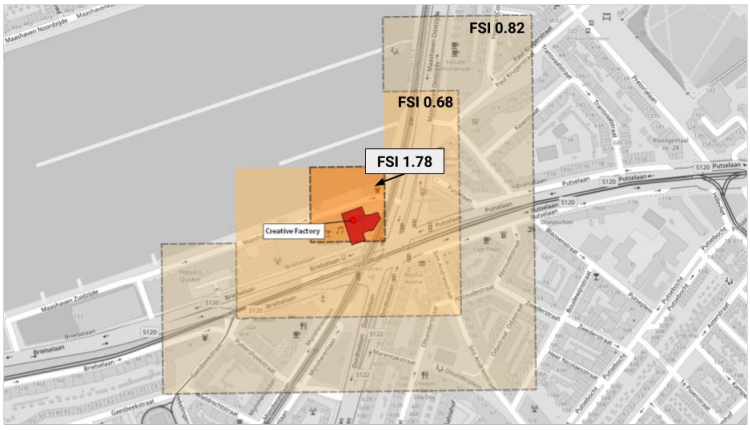
Figure 8.7: Location of the Creative Factory

Being located at the south-side of the river Maas, the river has to be crossed in order to reach the residency from the city centre and central station. However, because of a good public transport connection, the residency can still be reached from Rotterdam CS in roughly 10 minutes by subway.

The Creative Factory is enclosed by the old Maashaven on the north side, and busy roads Dordtselaan and Brielselaan on it's east and south side. This closed off location prevents any physical connections with the areas surrounding the Maassilo and makes the building secluded.

Although the area is densely populated, the FSI's of the areas surrounding the Creative Factory are not particularly high, as shown in figure 8.8. The comparatively low building densities can be attributed to the wide roads and some open green spaces that envelop the residency.

Figure 8.8: Density, as indicated by FSI, surrounding the Creative Factory



SOCIO-ECONOMIC CONTEXT

Besides many dwellings, filling up around 60% of the floorspace in the area, there is still some industry located along the Brielselaan. With approximately a quarter of the residents under 25 years old, and only 7% above 65, the area has a young population with many families and children. Originally accommodating many port workers, mainly from the southern dutch provinces, also later immigrants found a place to live here. Due to these migration movements in the past century, the area has become a multicultural district with over 150 different nationalities, and about 70% of the inhabitants having a non-dutch cultural background (Gemeente Rotterdam, 2018).

The area knows a number of initiatives, committed to improving the neighborhood. These residents are involved in multiple developments in the neighborhood and contribute to a more pleasant living environment. Retail in the area can mainly be found at the Dordtselaan. Within the two neighborhoods, many facilities such as elementary schools, health centers, churches and playgrounds are present (Gemeente Rotterdam, 2018).

RESIDENCY CHARACTERISTICS

The maassilo building consists of a complex of three silo's, built within a 50-year period between 1906 and 1956. The Creative Factory is located within part of the first silo of the complex. Distributed over 7 floors, separate office units and spots in shared spaces can be rented. The Creative Factory offers accommodation to around 25 companies, both to starting companies as well as more established companies. The overall focus of the Creative Factory is on the growth of (young) creative entrepreneurs. The connection with the Maassilo offers opportunities for tenants to organize events in the same building. The Creative Factory applies all-in rents, including services such as the use of a conference room, but also coaching and matchmaking between different companies are included (Creative Factory, n.d.).

The original idea for the Creative Factory was broad; thanks to the specific location amid residential areas in Rotterdam south, the residency would be focused on the young people of South. With intensive coaching, these people would be able to develop themselves into entrepreneurs and showcase their products in the building. Also more established entrepreneurs would be attracted to the building, providing an example. On business level, a combination of large-scale hospitality and offices would lay a strong financial foundation. The owner of the building, municipal Development Company Rotterdam, financed the whole development. The municipality provided approximately six million euros of subsidies, taken from the budget Kansenzones, which is used to support starting entrepreneurs in Rotterdam South. The

development of the Creative Factory coincides with three municipal programs, i.e. Pact op Zuid, Uitvoeringsprogramma Economie and Economische Kansenzones. This underlines the importance and relevance of the Creative Factory for economic and cultural redevelopment for the surrounding old city districts (Creating 010, 2015).

A combination with hospitality however, was never created. The Creative Factory became a stand-alone function within the building. Although RAAF, Factory010 and event location Maassilo are located at the same spot, these three venues feature mainly rentable event spaces (Creating 010, 2015). Events taking place in these venues are often either private, such as company events and weddings, or large events such as concerts, for which buying tickets is necessary. Although these venues are able to attract people, they are significantly different from approachable public spots, where the door is always open to residents of the area.

After several years, the building has barely had any positive effects on the area. Researchers and neighbourhood residents seem to share in this opinion. Possible reasons for this are the missing link with the neighbourhood, as the companies located in the Creative Factory and the residents have basically nothing in common. The residents have no idea of the things happening within the residency (RTV Rijnmond, 2016). Other factors contributing to this missing link are the absence of hospitality and the physical boundaries induced by the building and it's location (Creating 010, 2015).

RAAF

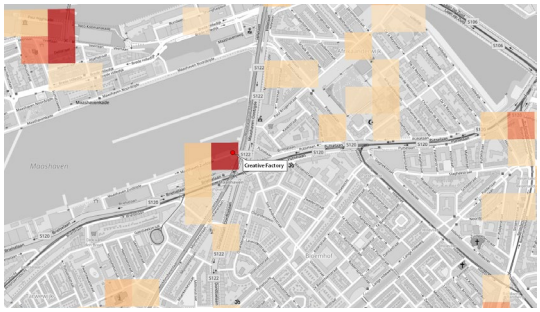
RAAF, short for Rotterdam-Art-Adventure-Food, has been some exception to the closed event venues located in the Maassilo building. Although RAAF also offers rentable event spaces, on the ground- and 7th floor of the Creative Factory, it's character differs from Factory010 and the Maassilo concept. Besides being located within the Creative Factory part of the building, and thus establishing a more direct link with the creative residency, they have had a partially open programme, with exhibitions, open stage nights, a weekly food concept and even yoga lessons. Furthermore, RAAF is strongly connected to 'Dit is Zuid', a foundation focussed on improving the image of Rotterdam Zuid and thus directly involved with the surrounding area.

However, RAAF has decided to put an end to it's current existence. From june 2018 their own programme will be finished and the renting out of their spaces will be taken over by the Maassilo (RAAF, n.d.).

8.2.2. Impact Assessment

IMPACT - SPATIAL

Figure 8.9 & 8.10: Heatmaps with vibrancy scores, Creative Factory, 1:5.000 and 1:10.000 respectively



Looking at figure 8.9, the consequences of a missing link with the neighbourhood can be witnessed. Although a vibrant cluster can be witnessed around the Creative Factory and Maassilo, the surrounding area does not show any spin-offs in terms of vibrancy. The cluster is very concentrated, and the high vibrancy is expected to be influenced by the massive events organized in the Maassilo hall itself.

In figure 8.10, another vibrant cluster in Katendrecht can be identified. However, this cluster surrounding the Fenix foodhallen, does not hold any connection with the Creative Factory.

IMPACT - TIME

Figure 8.11 shows a steady incline in vibrancy scores for the whole period of 2011 until 2017. The graph in figure 8.12 underpins these results, as it shows only minor relative growth percentages. The level of vibrancy is very high, which can be explained by the numerous mega events organized in the Maassilo. The second and third belt, are slightly following the pattern of the first belt. However, the effect is negligible as these areas clearly lag behind. This is in line with the results in figure 8.9, as well as the expectation on the basis of the case description.

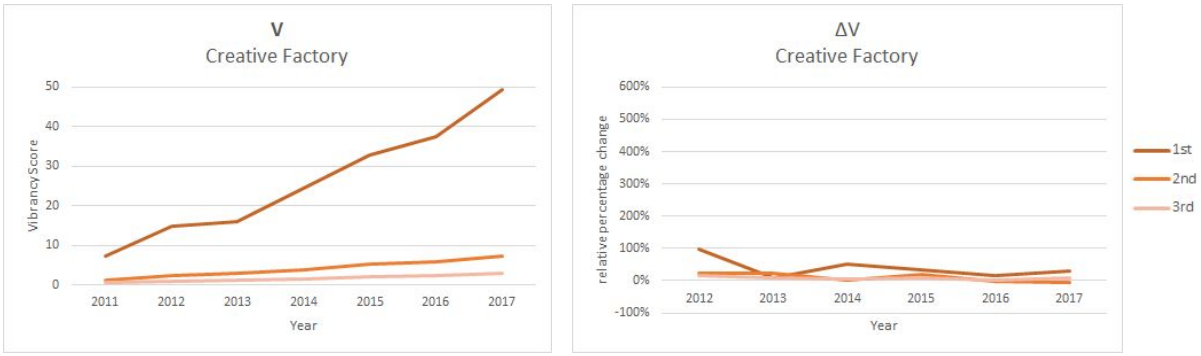


Figure 8.11 & 8.12: Vibrancy scores & relative percentage change for the 1st, 2nd and 3rd belts of the Creative Factory.

The high level of vibrancy is likely to be caused by the Maassilo, rather than the Creative Factory itself. To check properly whether this hypothesis holds true however, data for the period 2004 until 2011 is needed, which is unfortunately not available. Still, the whole building, whether that is the Maassilo or the Creative Factory, is shown to have negligible positive externalities. This can be attributed to the fact that, although many events may be organized, hospitality open to the neighbourhood's residents is missing.

8.3. Keilewerf

8.3.1. Case Description

LOCATION	Nieuw-Mathenesse
OPENING	2015
INITIATOR	Stichting Treehouse
GFA	6.000 m2.
COMPANIES	80
FUNCTIONS	Commercial space, Workspace, Events, Ateliers

INTRODUCTION

The Keilewerf started in 2014, as an initiative of Stichting Treehouse, in a vacant warehouse of 1.000 m2. Today, it is a creative hub accommodating over 80 young, creative entrepreneurs divided over 2 buildings measuring 6.000 m2 in total. An important characteristic is the encouragement of cooperation between the companies and entrepreneurs located at the Keilewerf, but also with initiatives and people not permanently located there. There are flex workplaces, a shared sawing mill and a small DIY building store with materials. Besides, festivals like “Keilefest” and “Once Upon A Time In The West” are organized here (Keilewerf, n.d.).

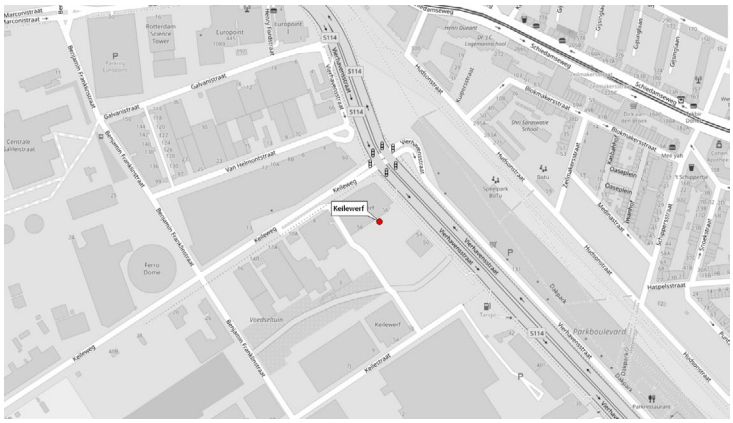


Figure 8.13: Location of the Keilewerf

PHYSICAL CONTEXT

The Keilewerf is located in an area dubbed the Merwe-Vierhaven. The area lies in the west of Rotterdam, bordering the neighbourhoods of Spangen, Delfshaven and the city of Schiedam. Being at the edge of the city, and originally an industrial area, the public transport connection is not great, taking around 20 minutes from Rotterdam Central Station. However, by bike you can reach the residency’s location within 12 minutes.

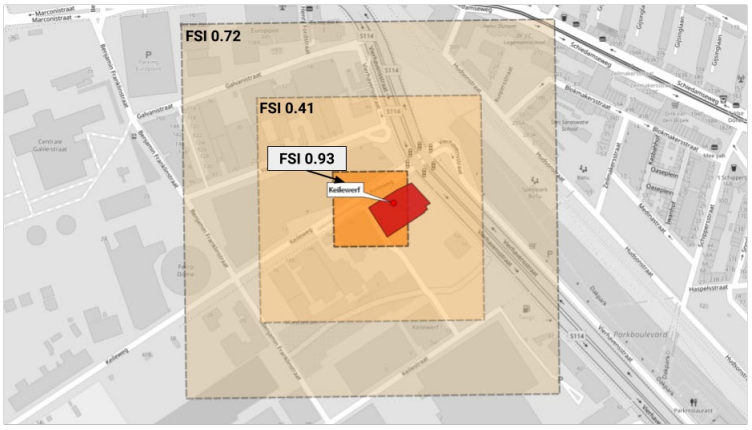


Figure 8.14: Density, as indicated by FSI, surrounding the Keilewerf

The area is characterized by a low density, as shown in figure x, and scattered with warehouses, DIY retail and some offices. Within this industrial area, the Keilewerf buildings are located at the large Vierhavensstraat, which provides the main access route to the area. On the other side of the Vierhavensstraat, a large retail strip is located. Beyond this retail strip lies the residential neighborhood of Bospolder. The retail strip and Vierhavensstraat however prohibit a strong physical link to the Bospolder residents.

SOCIO-ECONOMIC CONTEXT

The old industrial area of Merwe-Vierhaven, built in the early 1900's, once was one of the largest fruit ports in the world. Due to increasing foreign competition, the port was slowly vacated. It became a desolate area with a DIY building store and a streetwalker zone (Boddaert, 2015). The Merwe-Vierhaven quarter itself originally has no residential buildings, as it has always been a port. This has not benefited the vibrancy of the area in the past, and may be an explanation as to why the area became a streetwalker zone.

However, the Havenbedrijf and municipality of Rotterdam have made a strategy for the Merwe-Vierhaven quarter. Entrepreneurs and technological companies are the driving force in this strategy, but in the long run the area should facilitate living and working harmoniously. A first step towards living in the area is being made at this moment, as two of the three Marconi Towers are transformed into residential units (Boddaert, 2015; M4H Rotterdam, n.d.).

The building stores have been relocated to the other side of the Vierhavenstraat, where the old train tracks have been redeveloped into a retail strip. On the roof of the retail units a 1200 meters long park was realized in 2013, as a resident's initiative to create a social meeting place. Although this 'dakpark' is just on the other side of the Vierhavenstraat, it is not physically connected with the area as on ground level only the facades of the shops can be seen. The elevated park is connected with the urban fabric only on it's other side, making the retail strip a continuous barrier between the Merwe Vierhaven area and the residential area Bospolder on the other side (Let it Grow, n.d.; Peeters, 2015).

Besides the Keilewerf, numerous other buildings have been occupied by different types of companies in recent years. One of these buildings is an old gas storage facility, which accommodates the Ferro Dome since 2014, which is used for innovative music-, dance- and business events. Other examples are 'Uit je Eigen Stad', an initiative bringing agriculture and farming back into the city, and monumental office building HAKA, which is undergoing a transformation yet again at the moment (Boddaert, 2015; Liukku, 2017; Uit Je Eigen Stad, n.d.). Furthermore, next door to the Keilewerf, Studio Roosegaarde's Dream Factory is located in a former glass factory (Studio Roosegaarde, n.d.).

RESIDENCY CHARACTERISTICS

Both of the Keilewerf's buildings are old warehouses, with a total of 6.000 m2. The first building accommodates around 50 creative residents, while the second building is home to around 30 entrepreneurs. An interesting aspect is the number of creative individuals being located in one of the two buildings. This is boosted by the Keilewerf's flexibility; individuals or businesses can rent a space between 15m2 and 100m2. These spaces are rented out as empty lots, meaning tenants can design their workspaces completely to their own demands and wishes (Keilewerf, n.d.).

The Keilewerf's slogan translates to 'the yard where you can make everything/get everything made'. Looking at the diversity of residents, ranging from people making music and event planners, to furniture builders and bike designers, this slogan indeed seems to be true. A shared sawing facility and small DIY building store Buurman, are also accessible to non-permanent residents, ensuring the building is accessible to anyone (Keilewerf, n.d.).

Although as of this moment, no hospitality is located within either one of the buildings, the block accommodates multiple festivals and events during the year. Initially an annual festival on the parking of the Keilewerf, the Keilecafe will open in july 2018 as a permanent venue, accommodating a restaurant, bar and music performances.

ONCE UPON A TIME IN THE WEST

Since the summer of 2014 'Once Upon A Time In The West' is a festival where the collaboration and participation among the visitors are key. Along music and art performances, it futures a jacuzzi, yoga lessons and jamming sessions with artists who have just performed. In the run-up to the festival everyone is welcome to come and help with the building of the festival terrain. In collaboration with workshop Buurman, which is located within the Keilewerf 1 building, residual materials are used to turn the festival site into a work of art. This way, teamwork and a sustainable approach are pursued, making the festival unique and inspiring (Once Upon A Time In The West, n.d.).

8.3.2. Impact Assessment

IMPACT - SPATIAL

As shown in figure 8.15, the Keilewerf is located within a fairly vibrant cluster, especially when looking at the area surrounding the cluster. When looking at the wider Merwe-Vierhaven district, as illustrated in figure 8.16, a few vibrant spots can be identified. These include the Dakpark, Uit je Eigen Stad, and the Rotterdam Science Tower, which is one of the Marconi Towers. However, in general the area is not very vibrant and real linkages between the vibrant spots are non-existent. This is not very surprising as the area contains many physical barriers, of which the still existing industry and aforementioned retail strip are examples. Nevertheless, a somewhat spread-out vibrant cluster is surrounding the Keilewerf.

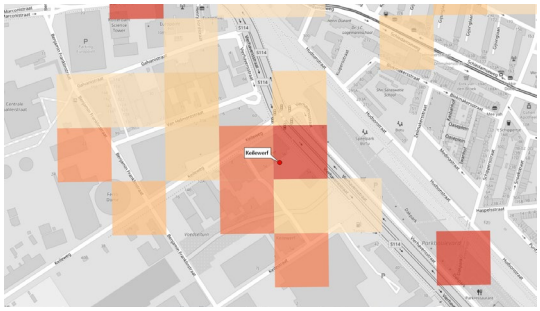


Figure 8.15 & 8.16: Heatmaps with vibrancy scores, Keilewerf, 1:5.000 and 1:10.000 respectively.

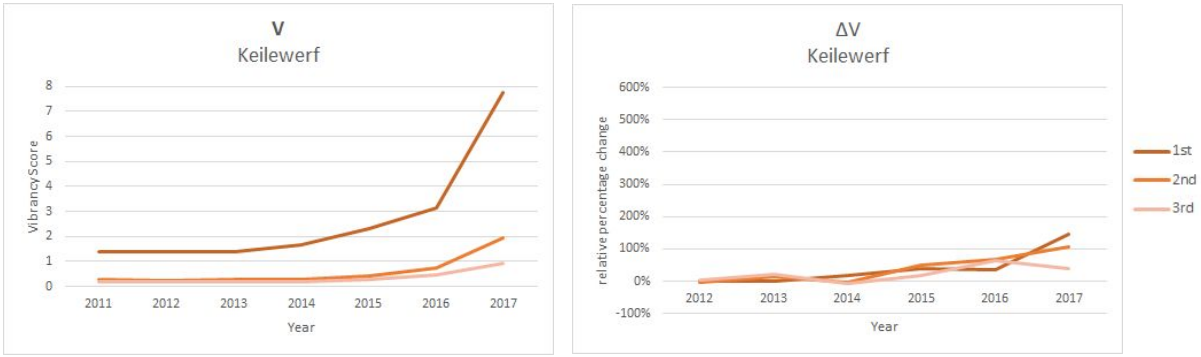


Figure 8.17 & 8.18: Vibrancy scores & relative percentage change for the 1st, 2nd and 3rd belts of the Keilewerf.

The relatively high vibrancy compared to the wider area of the Keilewerf can also clearly be witnessed when looking at figure 8.17. The figure shows a significant increase in vibrancy since 2015 in absolute terms. Although at a much lower level, also the second and third belt are following this increase. Figure 8.18 shows a moderate incline in percentage increases as compared to each previous years, in line with a steady exponential growth. Besides, figure 8.18 shows similar growth percentages for the second and third belt area, underpinning the belief that the Keilewerf indeed influences it's direct surroundings.

A critical note on the results is however that, in an area that was primarily industrial before, any other type of development will likely have a great impact on the area's vibrancy scores. Nevertheless, the fact remains that the vibrancy has increased significantly. Another important difference between this case and the previous one, is that the Keilewerf did not officially open it's doors before 2015. By then, social media was already used abundantly, providing more data to track and use in analysing changes over time.

8.4. Het Industriegebouw

8.4.1. Case Description

LOCATION	Stadsdriehoek
OPENING	2017
INITIATOR	Private parties
GFA	22.000 m2.
COMPANIES	200
FUNCTIONS	Eventspace, Cowork places, Offices, Meeting rooms, Hospitality, Retail, Pop-up Stores

INTRODUCTION

Realised in post-war Rotterdam, and designed by renowned architects Maaskant and Van Tijen, Het Industriegebouw is recognized as an icon of the rebuilding of Rotterdam after WWII. Originally commissioned by the Municipality of Rotterdam, the building was one of the first multi-company buildings ever built in the Netherlands. After deteriorating and being practically vacant for some time, Het Industriegebouw was bought by Rotterdam-based developers in 2015. The aim of the developers was to reinstate the original status and character of the iconic national monument. By the end of 2017 the residency has practically filled all it's space with over 200 different companies and a diversity of hospitality businesses and retail concepts (Het Industriegebouw, n.d.).

PHYSICAL CONTEXT

Het Industriegebouw is situated at the Goudsesingel, which marks the border between areas the Stadsdriehoek on the south and residential area Rubroek on the north. Both these areas are characterised by a large amount of post-war buildings, due to the heavy bombings of the historical centre during WWII. The Goudsesingel is a so-called city boulevard, i.e. one of the main roads within the centre of Rotterdam, with tram and bus lines. The specific quarter, the Hoogkwartier, lies just east of the city centre of Rotterdam (Beeksma, 2013). The residency's central location ensures good accessibility; from Rotterdam Central Station it can be reached within 10 minutes, both by bike and public transport.

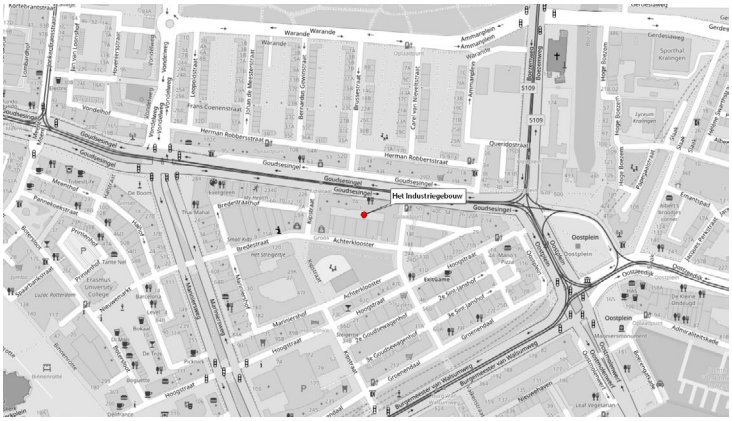


Figure 8.10: Location of Het Industriegebouw

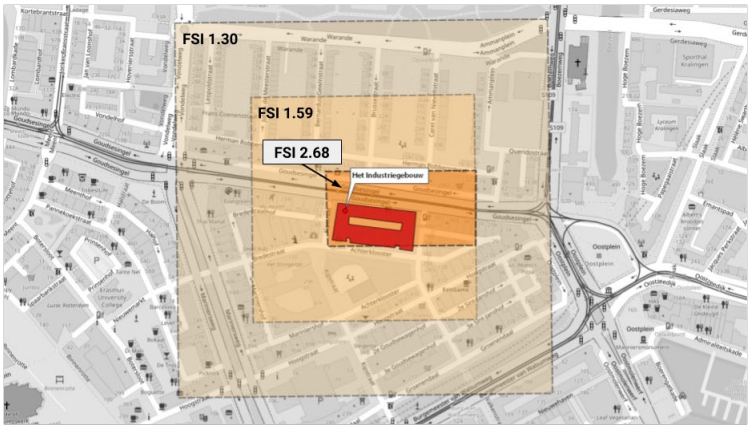


Figure 8.20: Density, as indicated by FSI, surrounding Het Industriegebouw

The area directly surrounding Het Industriegebouw, is characterised by a high building density, as shown in figure 8.20. However, when zooming out to a larger area, the average FSI drops, indicating lower densities and a more spacious layout.

SOCIO-ECONOMIC CONTEXT

The Stadsdriehoek area is a typical centre area, with lots of amenities, different types of shops and some well-known shopping- and hospitality areas, amongst which the Binnenrotte where the famous Markthal from OMA is located, the Meent and the Oude Haven (Gemeente Rotterdam, 2018). Rubroek on the other hand, has a more residential character, with some 8.400 inhabitants and relatively large groups of both young and elderly people. In the neighbourhood there is a dichotomy: On the one hand the area accommodates a group of highly educated, independent residents and on the other hand a group of less educated residents (Gemeente Rotterdam, 2018).

Being located at the brink of the Stadsdriehoek and Rubroek area, most of the floor space in the area surrounding Het Industriegebouw is residential, about 57%. Some 15% of the total space is used for retail, mostly located at the Goudsesingel and the Hoogstraat.

The Goudsesingel used to be an important market. However, after WWII the attraction of the Goudsesingel as a market has weakened due to heavy traffic on the street itself and it's off-center location. It was at the Hoogstraat, which is running through the centre of the Hoogkwartier, where the first signs of a steady transformation in the neighbourhood could be witnessed, with many new hospitality businesses and a more diverse supply of retail (Het Industriegebouw, n.d.).

RESIDENCY CHARACTERISTICS

The large building measures around 22.000 square meters, divided into a 6-storey U-shaped main building and a much smaller 2 storey building. Het Industriegebouw is both a multi-company building with progressive, creative companies as well as a place where leading hospitality and retail concepts have established themselves. At the moment, around 200 companies are located in Het Industriegebouw, renting a desk, studio, office, retail space or hospitality space in the building. Together these companies comprise around 1.000 individuals working in the building (Het Industriegebouw, 2017).

Professionals working in Het Industriegebouw are part of the building's community, which is an important aspect of the building's management. A key component in the make-up of this community is the diverse range of different companies and individuals, including creatives, start-ups, but also corporates (Het Industriegebouw, 2017). Famous architectural firm MVRDV is located in the smaller building since 2016. Besides being a famous tenant, the firm designed the interior for Groos, a design shop located in the building, and is working on a vision for the neighbourhood (Berkelder, 2017).

Not only a healthy mix of different companies, but also branding is seen as a important aspect by the building's management. Pop-up stores and hospitality were already brought into play pre-opening to draw people's attention and make the building known. Not only was this done to attract potential tenants, but it is also used as a way to connect with the neighbourhood. This focus on a connection with it's surroundings can also be found in the public character at street level. All street-level units have public functions, with a diverse range of restaurants and retail concepts. This way, the ground floor of the building is accessible to everyone and acts as a service for both residents of the building as well as the environment (Het Industriegebouw, 2017).

THE HIGHSTREET

The old service road in between the two separate buildings nowadays serves as a multi-functional outdoor space. It has been transformed into a public courtyard with terraces and greenery. Het Industriegebouw itself organizes drinks every friday and saturday for the building's residents, but also for everyone that wants to join. During summer, bbq's, outdoor cinema's and other events take place in the Highstreet. In winter, the outdoor space is covered so that the Highstreet can continue to receive guests and provide an active programme throughout the year (Het Industriegebouw, 2017).

8.4.2. Impact Assessment

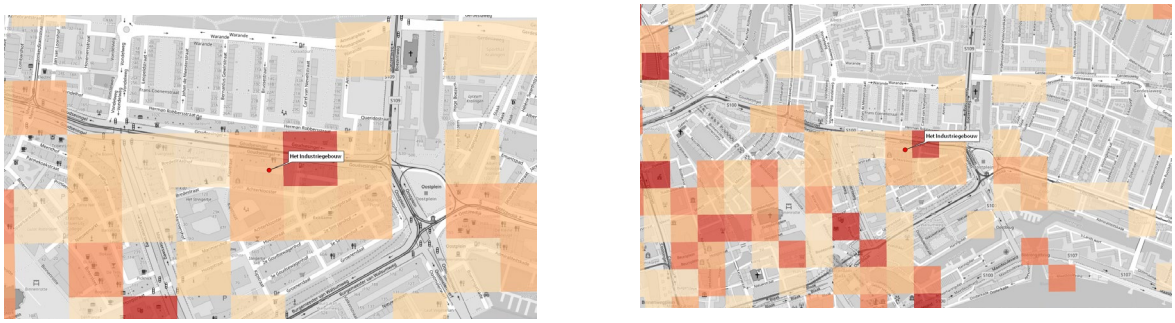


Figure 8.21 & 8.22 Heatmaps with vibrancy scores, Het Industriegebouw, 1:5.000 and 1:10.000 respectively.

IMPACT - SPATIAL

The location of Het Industriegebouw is located just outside the red, vibrant grid as seen in figure 8.21. However, when checking the facebook data, it is found that the exact geographic coordinates of the creative residency are actually located inside the red grid. One corner of the building is located inside this grid as well. As a consequence, all activities linked to Het Industriegebouw actually take place within this grid, rather than in the grid where the majority of the building is located in real life. Therefore it can be concluded that the creative residency is located in a vibrant cluster.

The orange belt enclosing Het Industriegebouw covers part of the Goudsesingel, and part of the aforementioned Hoogstraat. Zooming out further in figure 8.22, numerous vibrant areas can be identified. However, Het Industriegebouw, and the orange belt, still appear as a separate cluster. This indicates positive externalities in terms of vibrancy for the direct surroundings of Het Industriegebouw.

Figure 8.23 & 8.24: Vibrancy scores & relative percentage change for the 1st, 2nd and 3rd belts of Het Industriegebouw.

IMPACT - TIME

Figure 8.23 and 8.24 display positive results as well, showing compelling evidence that the area has seen a significant increase in vibrancy in recent years. However, the biggest boost in vibrancy already takes place between 2015 and 2016, when the residency was not officially opened yet. This can be attributed to the accommodation of MVDRV prior to the opening, can be a result of the fruitful branding and organization of events, or a combination.

8.5. Cross-case Comparison

In order to identify specific case characteristics that may be of influence on a residency's impact on vibrancy, the following paragraph compares the results of the different cases as presented in the previous paragraph. The most important case characteristics of all four cases, attaining to the physical context, socio-economic context, and the residencies themselves, are presented in table 8.1.

CASE CHARACTERISTICS

		Schieblock	Creative Factory	Keilewerf	Het Industriegebouw
Year of Initiation		2002/2009	2008	2015	2016/2017
No. companies		85	25	80	200
GFA		12.000 m2	2.500 m2	6.000 m2	22.000 m2
Public function		+	-	+	++
Location		Central	South	West	Central - East
Distance from Rotterdam CS	By Bike	3 minutes	15 minutes	12 minutes	7 minutes
	By Public Transport	5 minutes	11 minutes	20 minutes	12 minutes
FSI	1st belt 100x100	3.19	1.78	0.93	2.68
	2nd belt 300x300	2.51	0.68	0.41	1.59
	3rd belt 500x500	2.05	0.82	0.72	1.30
Land Use Mix 500x500m	% offices	35.7	10.2	13.7	8.1
	% residential	13.4	60.4	16.1	57.4
	% gathering	17.4	4.7	12.5	2.8
	% retail	8.6	5.8	19.1	14.4
	% industrial	5.7	14.7	32.8	7.1

Table 8.1: Case characteristics compared

IMPACT ASSESSMENT

In order to compare contrasting results in terms of vibrancy for the four different cases, an assessment is made on their performance relative to one another. The assessment of the case results, as compared to the other cases, is derived from the same case results as presented in paragraph 8.1 - 8.4. An overview of all the case results together, can be found in Appendix III. The case results are rated on a scale from - - to ++, as shown in figure 8.25. The rates take into account the opening years of the creative residencies, meaning that for the Schieblock and Creative Factory the whole period of 2011 until 2017 is taken into account, while for the Keilewerf and Het Industriegebouw only the results from 2015 and 2016 respectively are assessed.

ASSESSMENT SCALE
(in comparison with other cases):

++	residency performs very good
+	residency performs good
0	residency performs mediocre
-	residency performs bad
- -	residency performs very bad

	Schieblock	Creative Factory	Keilewerf	Het Industriegebouw
SPATIAL				
Dispersion of clusters	++	-	+	+
TIME				
Vibrancy score levels	++	++	+	+
Relative percentage change	+/-	--	-	+

Table 8.2: Case results combined

THEORETICAL INTERPRETATION

The key in comparing the distinguishing characteristics of the four cases, as outlined in table 8.1, is to generate theoretical hypotheses about the contrasting results in terms of vibrancy, as assessed in table 8.2.

Dispersion of clusters

When looking at the spatial dispersion of the clusters, it becomes clear that especially the Schieblock is located in a very dispersed vibrant cluster. This can be related to the amount of public functions accommodated in both the block and the building itself. However, the very central location and relatively diverse mix of functions of the area, are assumed to be an explanation as well, as to why the wider area is more vibrant in general.

The Keilewerf and Het Industriegebouw also show some dispersion. In the case of Het Industriegebouw this could again be attributed to it's relatively central location. However, the Keilewerf is located much farther from the city centre, and still shows some dispersion. The Creative Factory's vibrancy cluster on the other hand, although located further away from the centre as well, barely shows any dispersion. A major difference in characteristics between the Keilewerf and the Creative Factory can be found in the open, public functions of

both residencies. Although no permanent hospitality is located within the Keilewerf yet, the residency has an open character, as some of it's functions are accessible to non-residents and multiple events are organized in or near the residency. The Creative Factory on the other hand, has been criticized for an insufficient connection to the neighborhood and lacks a public face. Besides the organization of primarily very large or private events in the Maassilo building, the residency remains inaccessible to non-residents.

Hypothesis 1: A connection with the neighborhood, through the presence of diverse hospitality and an open, public character, contributes to a more dispersed vibrant cluster.

Hypothesis 2: A central location and minimization of physical boundaries will positively impact the dispersion of vibrant clusters.

Vibrancy score levels

The two older cases, i.e. Schieblock and Creative Factory, show much higher levels of vibrancy, compared to the other two cases. Besides their age, the Schieblock and Creative Factory also differ in type of hospitality that is located within the same blocks or buildings. The Schieblock building itself accommodates club BAR, while clubs Annabel, Transportbedrijf and outdoor hotspot Biergarten are located within the larger city block. The Creative Factory is located within the same building as the Maassilo, Factory010 and RAAF, which together feature 15 different rentable spaces accommodating over 7.000 people in total. All these venues, located in or near the Schieblock and Creative Factory, are well-known for organizing events, attracting many people. This of course boosts the vibrancy levels seen in the results for these two cases.

Keilewerf and Het Industriegebouw on the other hand are much newer, being initiated in 2015 and 2016/2017. Besides, they do not accommodate permanent venues focussed on large-scale events. While Het Industriegebouw does contain multiple hospitality businesses, these businesses are relatively small. Both of these cases, except for some larger periodical events, thus accommodate no venues attracting crowds to events regularly, which results in lower levels of the vibrancy scores.

Hypothesis 3: The regular organization of large-scale events, will lead to high vibrancy scores for the concentrated cluster surrounding a creative residency.

The three hypotheses defined above, regarding the dispersion and levels of vibrancy, also underpin the belief that high scores do not necessarily mean more dispersion. Regularly organizing large events will boost the vibrancy levels, as measured by the model presented in this research. However, the presence of diverse hospitality and an open, public character contribute to more dispersion, and and thus a higher added value, for the wider area.

Relative percentage change

The relative percentage changes are especially of interest in the newer cases, as this way an significant impact after the opening of one can be witnessed. However, also an interpretation for the two older cases is given.

Both Schieblock and Het Industriegebouw show a high peak in their percentage change graphs, indicating a sudden boost in vibrancy scores. In the case of Schieblock this peak can be identified in 2013, which may be a reaction to the opening of BAR and the further completion of the Luchtsingel and associated DakAkker. Another smaller peak can be witnessed in 2015, when clubs Annabel and Transport opened next door to the Schieblock.

Het Industriegebouw shows a great boost in vibrancy scores between 2015 and 2016. Although the building officially opened it's doors in 2017, the building already hosted events and accommodated MVRDV since 2016.

At first glance, the other two cases do not show any specific peaks in their relative percentage change graphs, especially when compared on the same scale as the other two cases. However, zooming in on the relative percentage change graphs, it is found that the Keilewerf is still seeing an exponential incline in relative growth percentages since it's opening, in which the residency's 2nd and 3rd belt areas are entangled as well. As this trend is already set in motion before the opening of the Keilewerf, it could partially be attributed to the area's transformation as part of the M4H project, which has already been on the municipality's agenda since 2004 (Schaeken, Milosevic & Dalmeijer, 2014).

This contrasts with the course of the Creative Factory's graph, whose baseline is slowly declining. The difference between the two zoomed-in graphs, as shown in figure 8.26 and 8.27, could be attributed to the fact that the Keilewerf is quite a new residency, and hence still developing. The Creative Factory on the other hand is much older and may be dealing with a stagnating development.

Hypothesis 4: The opening of a creative residency causes a boost in that area's vibrancy.

Hypothesis 5: After the opening, new developments surrounding, or connected to, a creative residency, may further boost the area's vibrancy.

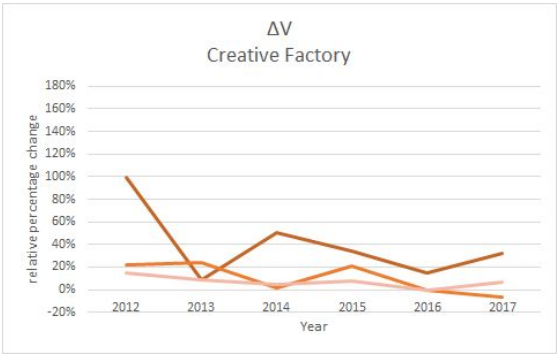


Figure 8.26: Zoomed-in relative percentage change of vibrancy, Creative Factory

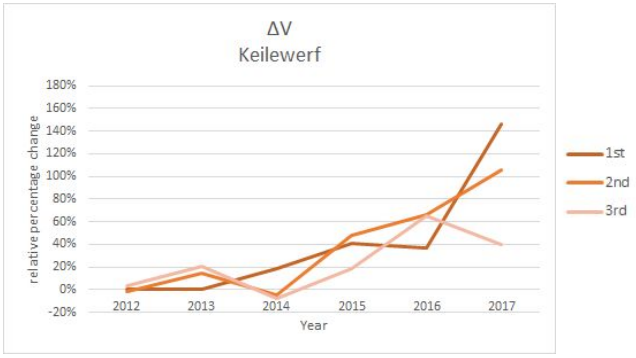


Figure 8.27: Zoomed-in relative percentage change of vibrancy, Keilewerf

PART III - FROM THEORY TO PRACTICE: TOWARDS A RESILIENT STRATEGY

“How can this added value be employed in resilient development practices?“

9. CONCLUSIONS & DISCUSSION

The aim of this research is to propose a methodology to quantify the impact of the creative sector on the vibrancy of it's urban area. The ultimate goal is to recommend approaches to how the results may be used in practice, in order to create a resilient urban area. The main research question is formulated as follows:

"How can the added value of creative residencies for an area's vibrancy be determined and used to design a resilient urban strategy?"

In the next paragraph this research question will be answered, providing the main findings related to the formulated subquestions. In paragraph 9.2. these findings will be compared with established theory. Furthermore, limitations concerning validity and reliability will be discussed.

9.1. Conclusions

Three sub questions have been formulated, which will be answered in this paragraph:

I. How can the vibrancy of an area be measured?

II. What is the impact of creative residencies on vibrancy?

III. Ultimately, how can this added value be employed in resilient development practices?

9.1.1. How can the vibrancy of an area be measured?

Building upon Jacobs' theory about vibrancy, and updating it to the 21st century by adding the importance of events and 'third places', a theoretical model of vibrancy is constructed. From Jacob's theory, four important indicators of a vibrant urban neighbourhood are extracted that could be effected by the presence of a creative residency. The relative importance of third places, as compared to other functions, and the possibility to track organized events as a proxy for the number of people attracted are included in the final construct of vibrancy.

The emergence of new data sources provides a possibility to test traditional theories and hypotheses with more sophisticated models. It has been found that big data provides many opportunities for a shift from research, traditionally characterised by data-scarcity, static snapshots and a coarse aggregation to studies that are data-rich, dynamic and entail high resolutions. The generated model employs these advantages by combining user-generated social media data with more traditional datasets retrieved from the dutch land register and the dutch census bureau.

The concept of vibrancy is in fact a latent variable, which means it is not possible to directly observe it. Using factor analysis, the multiple indicators from the theoretical model can be combined into one mathematical model, and the weights of their respective coefficients can be determined.

With the outcomes of the factor analysis, a vibrancy model is constructed. The model calculates a vibrancy score for every grid in every year between 2011 - 2017, by multiplying the standardized values of each variable by it's factor loadings. With this model an overall increase or decrease over time can be observed. However, to assess the growth in a certain grid relative to the level of the vibrancy scores in that grid, a second function is used. With this second formula, the relative percentage change can be used to compare the level of vibrancy in two years, while taking into account the level of vibrancy in that area.

9.1.2. What is the impact of creative residencies on vibrancy?

It is found that the creative residencies are located in vibrant clusters, which is in line with the expectations. However, the size and spread of these clusters, indicating positive externalities, differ per case. Besides, the time series analysis shows varying results for the cases as well. Not surprisingly, the impact of creative residencies on vibrancy is dependent on a multitude of factors, including the physical context and socio-economic context of the location and the characteristics of the residency itself.

Although it is clear that the different case characteristics bring about different results in terms of impact on vibrancy, it is impossible to determine exactly which characteristic amounts to which discrepancy in the results, within the current research scope. Nevertheless, it is possible to generate a number of hypotheses based on this research, regarding the added value of creative residencies:

Hypothesis 1: A connection with the neighborhood, through the presence of diverse hospitality and an open, public character, contributes to a more dispersed vibrant cluster.

Hypothesis 2: A central location and minimization of physical boundaries positively impacts the dispersion of vibrant clusters.

Hypothesis 3: The regular organization of large-scale events, leads to high vibrancy scores for the concentrated cluster surrounding a creative residency.

Hypothesis 4: The opening of a creative residency causes a boost in that area's vibrancy.

Hypothesis 5: After the opening, new developments surrounding, or connected to, a creative residency, may further boost the area's vibrancy.

The first three hypotheses defined above, regarding the dispersion and levels of vibrancy, support the belief that high scores do not necessarily lead to more dispersion. Regularly organizing large events will boost the vibrancy levels in the concentrated cluster. However, physical boundaries can block the linkage of a residency with it's surroundings, hindering spin-offs and therefore the positive externalities. Moreover, the presence of diverse hospitality businesses and an open, public character contribute to more dispersion, and and thus a higher added value, for the wider area.

Concluding, the concept of a creative residency thus entails more than just a collection of creative companies, as to have a positive impact on the area. A combination of connecting with the location, hospitality, a public face and the creative character, induced by the companies located in the residency, seems to hold the key when aiming for increased vibrancy in the area.

9.1.3. How can this added value be employed in resilient development practices?

Although some hypotheses about the added value of creative residencies have been defined, further research should be undertaken whether these hypotheses hold true. Nevertheless, the findings and results from the previous part provide possible approaches as to how the results may be used in practice. The following points provide the most important guidelines based on this research, for both the development of future creative residencies as well as the improvement of existing ones:

- When initiating a creative residency with the purpose of boosting the vibrancy of an area, just a collection of creative companies won't do the trick. To be vibrant, and therefore generate an added value in terms of economic income, people need to be drawn in. Just a creative residency in itself is unlikely to bring this, but combining it with hospitality, events and a public face in general seems to hold the key to being an attractive hotspot. In order to enable this, also municipalities should be aware of the importance of affording initiatives, contributing to a residencies vibrancy, the necessary permits.
- An area that knows a lot of physical boundaries and a low accessibility is unlikely to work on it's own. However when the previous advice is followed, and the development is part of a larger strategy, it is possible to achieve vibrancy in a secluded area, as illustrated by the Keilewerf. However, creation of physical linkages, and minimizing physical boundaries is recommended.
- On the other hand, achieving significant impact in an area that is more accessible and already attracts more people, is difficult as well. A location within the city centre is possible, but should be chosen carefully and provide something extra for the area. In that case a creative residency might still have a positive impact, as illustrated by Het Industriegebouw.

9.2. Discussion

In contrast to vested theories, it is not a given, at least not on a local, intra-city scale, that a creative hub will increase the vibrancy, and therefore supposedly improve socio-economic aspects as well. It is not solely the presence of creative companies that increases the vibrancy, and thus leading to a socio-economic added value. Although the importance of functions that are open and attractive to the public is not a surprising conclusion, it is not found explicitly in previous research concerning creative hubs.

This research also ties in with Rotterdam's wrecking ball debate, concerning the importance of transformation and reuse as opposed to demolition. Supporters of new development say the figurative wrecking ball frees up space for new dynamics in the city. However, the objective measures in this research show that old heritage can do exactly that, without the negative sustainability issues concerning demolition and new-built.

However, policy makers should still be wary when turning to the creative sector with the purpose of boosting an area's dynamics. Although the development of the Creative Factory was supported by the municipality and seemingly well-embedded in urban policy focussed on revitalizing the south of Rotterdam, the residency's results show barely any spillover effects for the wider neighborhood. One might even draw a parallel with the "urban renewal" plans in Newark of the 1960s, which included the construction of a large new medical school, right in the heart of the city's densely populated black community. Although it is not likely that the Creative Factory will accumulate in as much opposition as the 1969 Newark Rebellion, it is a reminder of failing top-down revitalization plans, without any real connection to an area's residents.

The aim of this research has been to quantify the concept of vibrancy, yet it has proven that without any qualitative interpretation the data remains meaningless. This is in line with the belief that big data is not as objective and value-free as one might think, as described in part 5.1.3. of this report. This research emphasizes that contextual or domain-specific knowledge is required when analysing and interpreting the results.

9.3. Limitations

Overall, vibrancy remains a concept that is hard to comprehend within a few variables. Due to the limited number of variables, the model as it is now, is sensitive to fluctuations within the data. These issues are exacerbated by the use of only one social media data source. Including numerous other indicators of vibrancy would likely improve the model, in terms of reliability and robustness.

Although not very accurate and reliable, using the Facebook platform, has provided access to a large pool of fine-scale data, that could otherwise not have been accessed within this research. However, user-generated data, like social media data, tends to be unreliable and inaccurate. This makes it hard to build a perfect model with this data, as lots of fields are inaccurate or missing. Even though the extent and granularity is much better than most traditional data sources, this still accounts for a lot of missing data, contradicting the belief that the extent of the data can account for the inaccuracies. Besides unreliability and inaccuracies, social media data tends to be biased, as it only applies to the people or businesses using a specific platform. Combining different sources of social media data, and other forms of big data, like for instance automated data, could make the research more robust and less biased. Besides, although this research succeeds in applying a small spatial scale, it is not able to assess differences in vibrancy on a small temporal scale. This is mainly due to an inadequate amount of data as well, and could also be solved using more advanced automated data.

Factor analysis in itself is a tool for validating instruments, as it seeks significant correlations between variables, suggesting they measure the same underlying concept. This means that the way the model is constructed in this research, is in itself already validated. However, the reproduced correlations, as shown in figure 6.4, might ideally have lower residuals. Improving the validity of the measurement further, could be achieved using more different variables and more reliable data, with less outliers. Also, only one factor was extracted in the current factor analysis, as the generated model is easy to interpret properly, and is therefore considered an acceptable fit. Extracting multiple factors however, although potentially making the model very hard to interpret, could improve measurement validity further.

This research has made clear that different case characteristics bring about different results in terms of impact on vibrancy, but it is not possible within the current research scope to determine exactly which characteristic amounts to which discrepancy in the results. This causes a low internal validity for the defined hypotheses, and subsequent recommendations for future practice. Besides, this research has focused on just four cases within the city of Rotterdam. The city of Rotterdam, and the four cases, are subject to a specific political, economical and social climate. This causes a low external validity as well, as extending the conclusions to any other context would not take into account general differences.

10. RECOMMENDATIONS

RECOMMENDATIONS FOR FURTHER RESEARCH

As discussed in the previous chapter, the most important limitations of this research are related to the constructed model, and more specifically the limited number of variables and the availability and accessibility of data. Further research within the topic of urban vibrancy should keep these limitations in mind and try to improve them. When looking at additional variables, these could be related to the spatial and physical lay-out of areas, like building density, accessibility and building upkeep, but also other proxies for the density and diversity of people and visitors could be added. Besides, network-theory could make this sort of study much more profound, as specific relationships and connections between different places could be taken into account.

Developing a model, using aggregation for smaller timespans, would enable analysis of differences in vibrancy per month, per day, or even during different times of the day. These small temporal scales could offer interesting insights, e.g. in which spots are vibrant during the day or at night. However, using automated data, like for instance GPS data or location data generated by mobile apps, would involve challenges regarding the accessibility and ethical issues.

As the external validity is low, expanding the research to other cases, cities and even countries could be very valuable. Although one should take into account general differences between cities and countries, it would then be possible to compare differences in vibrancy of cities as well. Connecting this comparison to for instance municipal policies in the different cities, recommendations for different types of policies can be made.

Although the developed model can thus become much more complex and robust, it can be used to apply a quantitative approach to the added value of creative residencies and presents an objective scale to assess changes in vibrancy. By doing so, it responds to the demand for more quantitative insights from the creative sector itself (Berkers, 2016). It also paves the way for future research examining urban vibrancy. Furthermore, the research promotes data-rich research in a more general sense within the fields of the built environment and urban dynamics. More and more data is being made available, through both official and unofficial sources, which will enable more in-depth and complicated quantitative models. However, it seems as if there still exists a gap between what is possible and what is applied in practice.

The question whether creative residencies indeed work as an incubator for economic and social improvement of urban areas has only partially been answered. Building further upon the vibrancy model constructed in this research, interesting opportunities for further studies can be found in investigating the effect of an increasing vibrancy on other indicators of urban regeneration. These aspects could involve economic indicators, such as house prices and spending, or social indicators, such as safety and social cohesion. The hypothesis that creative residencies will have a positive impact on an area's vibrancy, has only been proved to some extent within this research. The results have led to many more hypotheses regarding the specific characteristics influencing the dispersion and extend of this impact. Testing these hypotheses, as defined in 9.1.2., will be a valuable continuation of this research and could generate more specific and substantiated recommendations for resilient development practices. Furthermore, the method used in this research could be applied to other interventions in the built environment as well, assessing for instance the impact of developing a public park, shopping mall, or new iconic bridge.

RECOMMENDATIONS FOR PRACTICE

The results of this research provide straightforward and interpretable guidelines for developers and initiators of creative residencies in the future, as described in 9.1.3. as well. These guidelines can be utilized by creative companies wishing to initiate a creative residency, and seeking to add value to an area. The evidence-base provided by this research could support the initiation of these projects, by aiding in the negotiations with owners or the municipality about for instance rent- or sale prices (Berkers, 2016). But also municipalities can use this evidence-base to reassess their urban policy, improve their support of developments and ultimately boost vibrancy in low-scoring areas. Besides, it incites municipalities to provide permits for hospitality businesses and (outdoor) events and festivals, as these appear to be the most important factors in the added value of creative residencies.

This way, the results can be employed as driver for future transformation projects for the creative sector. It advocates the preservation of existing residencies and further development of future-proof residencies to accommodate the upcoming creative class, leading to a more diverse, inclusive urban area.

Furthermore, also other applications for practice of the vibrancy model are imaginable. For instance when combining the vibrancy model with land pricing, interesting investment or development opportunities. These can be assessed by identifying spots where a significant increase in vibrancy can be witnessed, but prices are still low.

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APPENDIX I SPSS output ULS Factor extraction

Descriptive Statistics

	Mean	Std. Deviation	Analysis N
#Venues	.13	.602	30056
#E/Day/2017	.19	2.530	30056
#E/Night/2017	.28	5.657	30056
#P/Day/2017	13.34	361.070	30056
#P/Night/2017	27.05	999.943	30056
DIV_LUM	.9689991141	.1040671613	30056

Correlation Matrix[a]

		#Venues	#E/Day/2017	#E/Night/2017	#P/Day/2017	#P/Night/2017	DIV_LUM
Correlation	#Venues	1.000	.625	.366	.283	.200	-.195
	#E/Day/2017	.625	1.000	.527	.410	.253	-.088
	#E/Night/2017	.366	.527	1.000	.251	.602	-.088
	#P/Day/2017	.283	.410	.251	1.000	.551	-.025
	#P/Night/2017	.200	.253	.602	.551	1.000	-.031
	DIV_LUM	-.195	-.088	-.088	-.025	-.031	1.000
Sig. (1-tailed)	#Venues		.000	.000	.000	.000	.000
	#E/Day/2017	.000		.000	.000	.000	.000
	#E/Night/2017	.000	.000		.000	.000	.000
	#P/Day/2017	.000	.000	.000		.000	.000
	#P/Night/2017	.000	.000	.000	.000		.000
	DIV_LUM	.000	.000	.000	.000	.000	

a. Determinant = .145

Inverse of Correlation Matrix

	#Venues	#E/Day/2017	#E/Night/2017	#P/Day/2017	#P/Night/2017	DIV_LUM
#Venues	1.703	-.992	-.052	-.042	-.027	.238
#E/Day/2017	-.992	2.340	-1.102	-.790	.702	-.082
#E/Night/2017	-.052	-1.102	2.333	.712	-1.504	.068
#P/Day/2017	-.042	-.790	.712	1.836	-1.232	-.007
#P/Night/2017	-.027	.702	-1.504	-1.232	2.411	-.032
DIV_LUM	.238	-.082	.068	-.007	-.032	1.044

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.547
Bartlett's Test of Sphericity	Approx. Chi-Square	58133.869
	df	15
	Sig.	.000

Anti-image Matrices

		#Venues	#E/Day/2017	#E/Night/2017	#P/Day/2017	#P/Night/2017	DIV_LUM
Anti-image Covariance	#Venues	.587	-.249	-.013	-.013	-.007	.134
	#E/Day/2017	-.249	.427	-.202	-.184	.124	-.033
	#E/Night/2017	-.013	-.202	.429	.166	-.267	.028
	#P/Day/2017	-.013	-.184	.166	.545	-.278	-.004
	#P/Night/2017	-.007	.124	-.267	-.278	.415	-.013
	DIV_LUM	.134	-.033	.028	-.004	-.013	.958
Anti-image Correlation	#Venues	.709[a]	-.497	-.026	-.024	-.013	.178
	#E/Day/2017	-.497	.563[a]	-.472	-.381	.295	-.052
	#E/Night/2017	-.026	-.472	.531[a]	.344	-.634	.044
	#P/Day/2017	-.024	-.381	.344	.503[a]	-.586	-.005
	#P/Night/2017	-.013	.295	-.634	-.586	.481[a]	-.020
	DIV_LUM	.178	-.052	.044	-.005	-.020	.599[a]

a. Measures of Sampling Adequacy(MSA)

Communalities

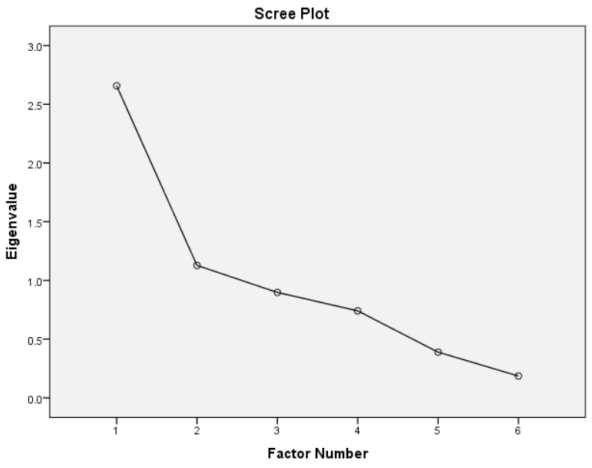
	Initial	Extraction
#Venues	.413	.347
#E/Day/2017	.573	.541
#E/Night/2017	.571	.501
#P/Day/2017	.455	.308
#P/Night/2017	.585	.368
DIV_LUM	.042	.018

Extraction Method: Unweighted Least Squares.

Total Variance Explained

	Initial Eigenvalues			Extraction Sums of Squared Loadings		
Factor	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	2.658	44.297	44.297	2.082	34.706	34.706
2	1.128	18.799	63.097			
3	.898	14.966	78.062			
4	.741	12.347	90.409			
5	.389	6.489	96.898			
6	.186	3.102	100.000			

Extraction Method: Unweighted Least Squares.



Factor Matrix[a]

	Factor 1
#E/Day/2017	.736
#E/Night/2017	.708
#P/Night/2017	.606
#Venues	.590
#P/Day/2017	.554
DIV_LUM	

Extraction Method: Unweighted Least Squares.

a. 1 factors extracted. 4 iterations required.

Reproduced Correlations

		#Venues	#E/Day/2017	#E/Night/2017	#P/Day/2017	#P/Night/2017	DIV_LUM
Reproduced Correlation	#Venues	.348[a]	.434	.417	.327	.358	-.079
	#E/Day/2017	.434	.541[a]	.521	.408	.446	-.098
	#E/Night/2017	.417	.521	.501[a]	.392	.429	-.094
	#P/Day/2017	.327	.408	.392	.307[a]	.336	-.074
	#P/Night/2017	.358	.446	.429	.336	.368[a]	-.081
	DIV_LUM	-.079	-.098	-.094	-.074	-.081	.018[a]
Residual[b]	#Venues		.191	-.051	-.043	-.158	-.116
	#E/Day/2017	.191		.007	.002	-.193	.010
	#E/Night/2017	-.051	.007		-.141	.172	.006
	#P/Day/2017	-.043	.002	-.141		.215	.048
	#P/Night/2017	-.158	-.193	.172	.215		.050
	DIV_LUM	-.116	.010	.006	.048	.050	

Extraction Method: Unweighted Least Squares.

a. Reproduced communalities

b. Residuals are computed between observed and reproduced correlations. There are 8 (53.0%) nonredundant residuals with absolute values greater than 0.05.

Factor Score Coefficient Matrix

	Factor 1
#Venues	.166
#E/Day/2017	.355
#E/Night/2017	.282
#P/Day/2017	.169
#P/Night/2017	.219
DIV_LUM	-.034

Extraction Method: Unweighted Least Squares.
Factor Scores Method: Regression.

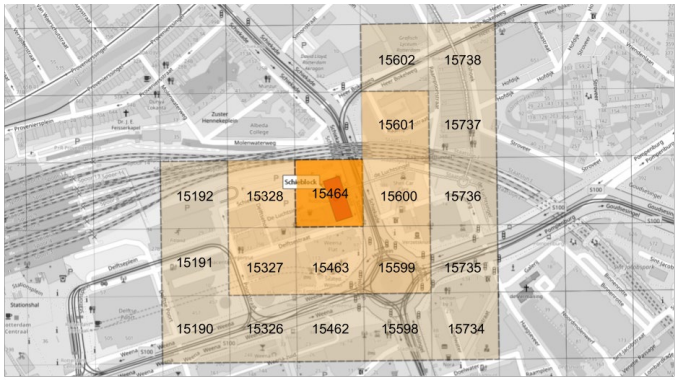
Factor Score Covariance Matrix

Factor	1
1	.790

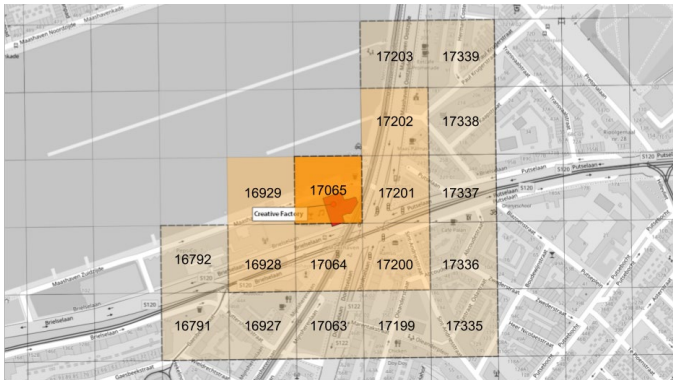
Extraction Method: Unweighted Least Squares.
Factor Scores Method: Regression.

APPENDIX II 1st, 2nd and 3rd belt Grid IDs

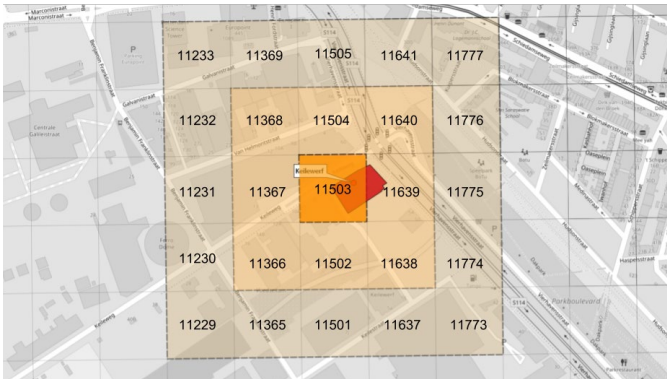
Schieblock



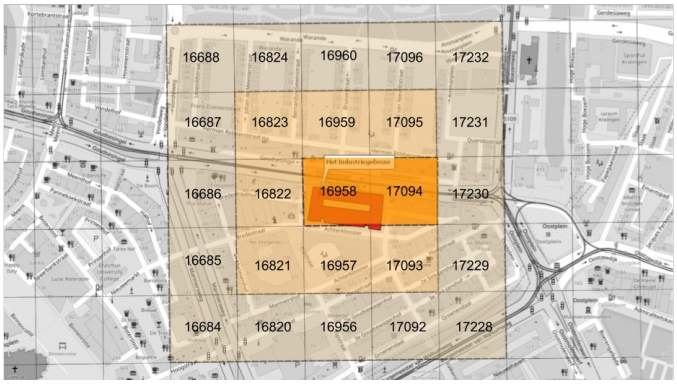
Creative Factory



Keilewerf



Het Industriegebouw



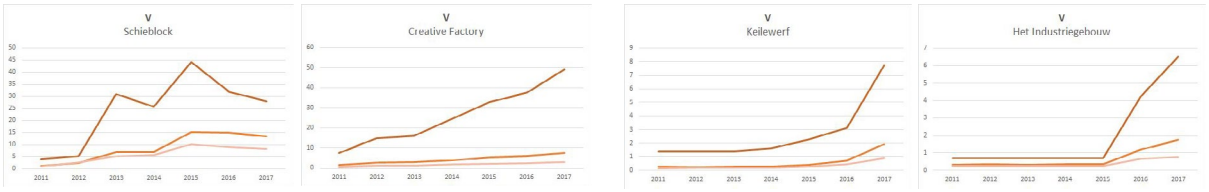
APPENDIX III Case Results Combined

SPATIAL ANALYSIS

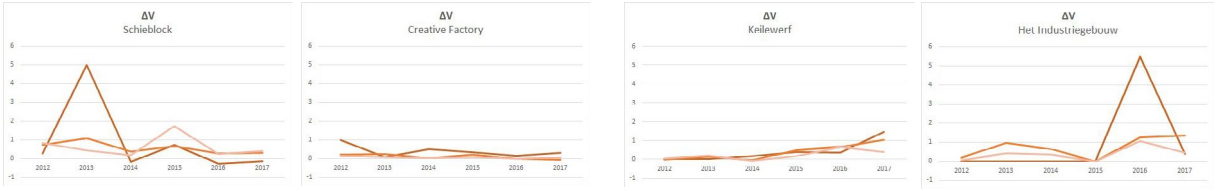
Dispersion of clusters

TIME SERIES ANALYSIS

Vibrancy score levels



Relative percentage change



APPENDIX IV Personal Reflection

From the start, I had a clear idea of a first outline for the research design. Favoring objectivity above subjectivity myself, I wanted to take a quantitative approach. While exploring the topic further, through both exploratory talks with stakeholders and literature review, the positive effects of the creative sector appeared to be not as obvious as believed by many policy-makers and theorists. After many years of implementing 'creativity and culture' in urban regeneration policies, the evidence base to support this is still not solid.

However, due to difficulties in demonstrating causalities and the availability of sufficient and accurate data, many problems arose surrounding the tangible effects of the creative sector. By choosing to focus on vibrancy, instead of socio-economic effects as a whole, I tried to reduce the scope. Although reducing the scope, this has added another layer of operational research on 'how to measure vibrancy' to my research. Next, finding enough and accurate data for the quantitative part of this research has proven to be a challenge. This has led to incorporating big social data as a proxy for urban vibrancy.

Although I had some basic knowledge of the concepts and challenges of using big data and did some basic statistical analyses before, I really challenged myself by using them more in depth for this research. Before I knew it, I was sifting through doctoral theses of computer scientists. The collection, and especially the cleaning, of the data has taken up a lot of time, which I did not really anticipate. Still, I'm really excited about the topic and methods I chose, not only because I think it produced interesting results and thesis in the end, but even more so because I've forced myself to learn and apply new things instead of reproducing what I had already learned.

Also the complexity, inherent to urban dynamics, has proven to be a challenge. Creating a resilient strategy, which initially was (and ideally would still be) the end goal, touches upon so much different fields, ranging from politics, to economic conjuncture and financing issues, that I didn't achieve this. Besides, the topic of gentrification comes into play here as well, with all the intricacies and controversies it entails. Concluding, I believe that the overall results of my research are applicable in practice in several ways, although the model should be expanded to fit other purposes. In it's basis however, it could be applied to different cities and even different countries.

THE ADDED VALUE OF CREATIVE RESIDENCIES

A research into the tangible effects of the creative sector on vibrancy