

Smart Cities – a New Revitalisation Approach for Shrinking Cities?

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1 ABSTRACT

Smart City applications can be a new technological and sustainable approach to revitalize cities effected by structural economic changes and transform them into future oriented and livable places. By means of the case studies City of Bochum, Germany and the City of Cincinnati, Ohio, USA comparative planning approach presented.

Keywords: Urban revitalization, Substitute industries , Shrinking Cities, Smart Cities , Resilience

2 INTRODUCTION

As globalization causes ongoing local and regional structural economic transformation processes, big challenges arise for today's urban planning (Tverberg, 2013). Post-industrial transformations can lead to declining manufacturing industries and therefore to a decline of local jobs. This has among other causes effects on the urban landscape (Pallagst, 2007). The deindustrialisation and consequently out-migration of people has lead to the shrinkage of cities with visible changes such as declining and abandoned neighborhoods with derelict buildings (Hollander et.al., 2009).

As defined by the Shrinking Cities International Research Network (SCiRN) a shrinking city is an urban area of at least 10.000 inhabitants that has or is currently facing large population losses for at least two years. Additionally, the city is faced with structural economic transformations and its symptoms (Siedentop and Wiechmann, 2007).

Cities struggle with regenerating themselves based on new societal challenges (e.g. sustainability) and new substitute industries to stabilize the urban fabric and stop further shrinkage. Methods and new planning approaches have been applied in many old industrialized regions around the world. These measures often include substitute industries. This is defined as a primary creation of new/ other jobs as well as a strategy for the general revitalization or restructuring of the local economy. However, the term 'substitute industries' does not give any concrete pointers to a specific industry or sector (Pallagst 2017).

Due to the shifts in economic structure, cities are left with many old industrial and commercial brownfield sites in urban areas (Häußermann et al. 2005, p.12). Many programs, instruments and specially designed projects of the last decades have failed to provide the necessary results aimed at revitalizing these brownfield sites (Schackmar et al. 2018).

The role of technology is advancing, and – consequently - smart city developments aim towards technological solutions as job replacements and strategies for revitalization. Besides modifications of local governance and increased efficiency, they introduce technological applications to urban planning and cities (Schackmar et al. 2018).

The term 'smart city' is being used as a general leitmotiv for cities, as well as part of the discussion among urban and regional development models and planning in general (Vanolo, 2013). Smart cities are widely being discussed and defined in the literature, but their conceptualisation is still hard to grasp, as there are many different ways to include or exclude certain applications. Osborne and Rose have defined smart city as being framed as an efficient, green and socially inclusive and technologically advanced city (Osborne, T et al., 1999). A more recent attempt at defining what elements smart city could foster was published in the ISOCARP Review 2017, determining four pillars: sustainability, efficiency, people and security.

Since in shrinking cities many instruments and initiatives were applied in the past with more or less successful outcomes, new smart city related solutions could pave the way for revitalization. The research presented here argues that urban planning might play a role in bringing this technological framework forward, to cater to the needs of shrinking cities in a more efficient, social and sustainable way. By providing necessary frameworks and new urban laboratories, a new way to utilize the potential of smart city applications could shed light on issues unsolved today. In particular, applying these new technologies might reduce the use of city resources (e.g. municipal finance) as well as raise the quality of life for the inhabitants,

or introduce new ways of mobility and services to the city (Gassmann et.al., 2018, p.18). This might create new substitute industries providing jobs in innovative economic fields.

This research aims is to analyze the strategy of introducing and applying smart city technology as a substitute industry in shrinking cities. In this context, the paper discusses introducing smart city strategies and technologies to reinvent shrinking cities.

The paper will present empirical results of an analysis based on case study examinations of the City of Bochum, Germany and the City of Cincinnati, Ohio, USA. The analysis of these cases might generate knowledge on the success and lessons that smart cities could provide for shrinking cities.

3 SHRINKING CITIES

3.1 Introduction to shrinking cities

The phenomenon of shrinking cities is not one limited to a country or a (global) region but rather an internationally observed process, set in motion by globalisation and structural transformations. Leading to long term demographic and economic changes, especially in old industrial regions or peripheral rural areas. Those causes and effects can have different triggers and turn out differently but the result for cities or urban areas is not that different. Changing demographics and declining birth rates in western Germany as well as the reunification effects on the eastern part of the country caused shrinkage (Pallagst, 2008).

The Shrinking Cities International Research Network (SCiRN) has characterized a shrinking city as an urban area of at least 10.000 inhabitants that has or is currently facing large population losses for at least two years. Additionally, the city is faced with structural economic transformations and its symptoms (Siedentop and Wiechmann, 2007).

3.2 Causes and consequences of shrinkage

The causes that can lead to a shrinking of the city include various aspects. These can occur individually or parallel and, depending on the location, depending on the individual case. The following four indicators are characteristic of the causes of urban shrinkage:

- The decline of a city-dominating economic area or several areas
- Emigration of the population (suburbanization and long-distance migration)
- Deindustrialization (in general)
- A particular concern in monostructured regions (Henckel, 2003; Liebmann and Kühn, 2010).

The above-described, mostly economic shrinking phenomena and the relocation of entire industries and the associated loss of jobs also include other causes: the old industrial regions and post-industrial regions of the mining and steel industry in western Germany, especially in the monostructured Ruhrregion (Ellrich and Neuhaus, 2012; Glock, 2007, p.1).

The natural population development in Germany is an important factor. Measured with the natural birth rate, this has been negative since 1972. However, demographic-related population losses cannot be as severe according to the latest developments. This means that Germany's population has only increased due to immigration for some decades or has remained relatively stable. Germany is currently experiencing positive population growth on average. This is based above all on immigration from economically weakened European countries and on refugee movements from the crisis regions of the Middle East and Africa since summer 2015 (Destatis, 2020; Breuer 2017).

There is also a shift in the average age due to falling birth rates and increasing life expectancy. By the middle of the century, the proportion of over-60-year-olds in Germany is expected to increase from one fifth of the population to around one third (Statista, 2020; Spiegel Wissenschaft Online, 2007).

In addition to this so-called aging population, there is selective emigration of mostly young, qualified and work-oriented citizens. This population development takes place especially in cities. It can therefore be concluded that the population is migrating if there is no prospect of a job on the job market and there is a lack of training or study opportunities (Deutsche Akademie für Städtebau und Landesplanung, 2002, S.7ff).

City shrinkage processes can thus be seen as a consequence of a structural change. The associated social change is another cause of the changes that have occurred due to structural change. However, short-term positive growth impulses due to immigration or increased birth rates do not take place in every region of Germany.

3.2.1 Consequences of shrinkage

Looking at the causes shows that urban shrinkage is a phenomenon that can have diverse and far-reaching reasons or origins. The shrinkage can be different locally and / or regionally. Nevertheless, it is based on the two indicators: the loss of inhabitants and the profound change in the economic structure. The following paragraphs are displaying the various effects of shrinkage:

3.2.2 Economy and job market

A weakened economic base (mostly in the mining or industrial sector) is the direct consequence of the decline of one or more local or regional economic sectors. The economic situation is characterized by a lower number of jobs and consequently also training opportunities. This weakened base can lead to increased emigration of young and well-educated people. This process can lead to a drastic labor shortage in the long run. In particular, medium-sized companies and the establishment or relocation of innovative companies can be negatively influenced (Institut für Landes- und Stadtentwicklungsforschung und Bauwesen des Landes Nordrhein-Westfalen (ILS NRW), 2003, S.A4).

Generally, it can be said that the so-called self-preservation cycle of the economy is disturbed. This means that if one or more important employers break away, this automatically has consequences for other branches of the economy. Here, for example, lower purchasing power (due to higher unemployment and moving away) has to be listed, which has a noticeable impact on the local economy. Visible effects are expected to result from vacancies in the inner-city retail sector (Bundesministerium für Verkehr, Bau und Stadtentwicklung, 2010; Winkel, 2002 S. 99ff).

This sets in motion a "downward spiral", which is made up of the following concise factors:

- Population decline (migration losses and low natural fertility rate)
- high unemployment (severe job losses)
- Loss of purchasing power and real tax
- declining financial strength of private and public budgets (due to falling tax revenues)
- Declining investments by private and public households (in companies and infrastructure)
- Image loss

The factors listed often lead to self-reinforcing urban shrinkage (Häussermann et al. 2005, p. 12).

3.2.3 Spatial consequences of structural change

The spatial consequences of structural change include inner-city vacancies and the urban sprawl and suburbanization of the urban fringe areas. This is mainly borne by families with higher incomes looking for a family home in the countryside (Glock, 2007).

A new aspect is the formation of location clusters. Many municipalities or regions have their own cluster concepts for this and try to locate and promote them in a targeted manner. The main focus here is on the new economy, i.e. companies in information and communication technologies. But developments in the logistics industry also play a major role. A dominant feature of the space here is, for example, the increase in logistics centers, both in terms of their number and in terms of their area (Henckel, 2003; Haas, 2017).

This development also includes the developments of large tertiary institutions (including service, research and education centers) on the outskirts. As a result of the rapidly changing economy and the migration or bankruptcy of companies, wastelands are emerging on many previously used commercial or traffic areas. As a so-called no man's land, they usually wait years for revitalization, i.e. a commercial or general structural connection use or renaturation. This release of space can be seen as a space-defining element of structural change (Henckel, 2003).

3.2.4 Infrastructure and traffic

Due to the spatial impact of shrinkage, the mobility behavior of citizens is also changing. Due to the urban sprawl and suburbanization of the peripheral urban areas, access by public transport is only possible to a limited extent. Due to the poor accessibility and frequency in these areas and less comfort than in private cars, public transport is unpopular. As a result, more citizen commute and car traffic and car density increases in the inner cities. Likewise, the noise and pollutant emissions, which have an overall negative impact on the attractiveness of the municipality (Institut für Landes- und Stadtentwicklungsforschung und Bauwesen des Landes Nordrhein-Westfalen (ILS NRW) 2003., S.A4-A5).

A city's infrastructure does not only include services of general interest, but also the technical, social and cultural infrastructure. This includes traffic routes such as roads, public transport, schools and sports fields, swimming pools, facilities such as kindergartens or hospitals, but also theaters. It is only possible to a limited extent to quickly adapt the infrastructure to changing needs as the population decreases. Here, supply and demand are not linearly related. As demand falls, the city has to adjust the offer, but this happens only slowly. As a result, fewer taxpayers will have to bear the same or rising costs for the oversized supply. The municipal financial crisis is getting worse (see next section: Municipal Finances; Institut für Landes- und Stadtentwicklungsforschung und Bauwesen des Landes Nordrhein-Westfalen (ILS NRW) 2003, S.A4-A5).

While the existing infrastructure in the inner cities is getting under increasing cost pressure, in many places in the peripheral urban areas a new infrastructure is being built due to the development pressure on these spaces. A paradox that poses a major challenge for local politics. This infrastructure is built for a thinner settlement density than in the cities. It therefore costs more to the individual because it is used by fewer people. At the same time, existing infrastructure or entire neighborhoods are being dismantled in shrinking cities (Ellrich and Neuhaus 2012).

The infrastructure can no longer be maintained at the usual level due to a lack of funds or less funds. A downward trend sets in, with savings being made on modernization first, then general maintenance can no longer be financed and finally, the complete dismantling or decay is due. This is also known as aging or investment backlog. There is a risk that the city will shrink even further if the public infrastructure is in a bad state since emigration can increase due to an unattractive appearance (Institut für Landes- und Stadtentwicklungsforschung und Bauwesen des Landes Nordrhein-Westfalen (ILS NRW) 2003, S.A4).

3.2.5 Municipal finance

Due to the emigration of the young and work-oriented population class, a monostructured social, age and nationality structure is emerging in the inner cities of shrinking cities. This factor, on the one hand, and the general income and expenditure policy of the municipal budgets, on the other hand, result in a structural loss of income for the municipality concerned. Above all, the directly falling and missing municipal income through wage and income tax should be mentioned. Trade tax is another important direct source of income for municipalities. The loss of large companies in an economically monostructured community can quickly lead to precarious financial conditions. Missing indirect income such as contributions and fees as well as key allocations by the state and the federal government also contribute to a constantly negative budget situation (Winkel 2002; Milbert and Gatzweiler 2009, Institut für Landes- und Stadtentwicklungsforschung und Bauwesen des Landes Nordrhein-Westfalen (ILS NRW) 2003, S. A7-A8).

3.2.6 Social consequences and housing

Further consequences and effects of structural change are due to the persistently high unemployment rates and the emigration of certain social or age groups in cities that are characterized by shrinkage. Those who are too poor, too unqualified or too old to migrate concentrate in the city centers. This development becomes clear based on a massive structural vacancy rate. With the loss of the financially stronger classes, the development of the housing market is one of the obvious signs of social change and its effects. With the concentration of vacant buildings and financially weak owners, there is a visible downward trend in the structural condition of the buildings and the public space. Entire neighborhoods, streets and neighborhoods can deteriorate (Glock 2007; Ellrich and Neuhaus 2012; Spellerberg et al. 2008, pp. 39-40).

The social decline due to unemployment and living in a district affected by the decline is causing stigmatization of the inhabitants (Glock 2007).

Concluding this chapter, city shrinkage is therefore a multi-dimensional process. These consequences and effects of the city shrinkage, which are shown above, depicting the breadth of the tasks with which an affected municipality has to deal with. It has emerged that with job losses, a spiral of self-accelerating decline can begin. The resulting, sometimes existential consequences (for the municipalities) reveal the question: Can shrinkage of a city be stopped, mitigated or prevented if enough alternative, new jobs are created or other measures of revitalization have been applied?

Creating or relocating new and alternative jobs for workers who have lost their jobs due to structural change is a lengthy and complex task (Peuling, 2017). The key to success seems to be the creation of a so-called substitute industry for the community or generate other beneficial ways to attract jobs.

3.3 Revitalization approaches

Having identified the need for revitalisation approaches to cope with shrinkage and its effects many cities identified the need to diversify their economic basis. Thus, various policies and strategies have been developed. Most dominating is the approach to introduce new innovative industries to the cities economy, in order to revitalise the economic basis of the city.

The replacement of an industry (entire branch within a municipality or region) in the form of a new one, which generates work and added value on a similar scale, is generally regarded among shrinking municipalities as the so-called "key solution" for the stability of the city. This should enable the city and its population to continue to exist and prevent further shrinkage (Peuling, 2017).

The term "substitute industries" is been used to describe the primary replacement of jobs and the strategies for the general revitalization of the local economy. The term "substitute industries" does not provide any specific information about a specific economic branch or sector. In the USA in particular, this term has been reflected in the respective literature. Since manufacturing and mining companies have migrated or gone bankrupt, there has been no city in the United States, especially in the rust belt, that has made no effort to locate "substitute industries" (Pallagst, 2017).

Many cities in old industrialised areas have tried to revitalise and attract substitute industries. These industries run along the lines of culture, education and medicine, high-tech and IT, green infrastructure and last but not least the festivalization of cities. These are some (among other) prominent examples of often tried and applied substitute industries. Overall lies the goal of becoming more sustainable and resilient as a whole.

In terms of technological advances, one topic of focus must be mentioned in more detail:

3.3.1 Hightech and IT

The further mechanization or rather computerization of society, research, administration and the production of goods and services will continue unabated in the coming decades. The developments in the high-tech industry and IT sector are global or in every economic sector and are characterized by a great dynamic of innovations. Therefore, the promotion and settlement of companies and institutes in this area is particularly future-proof, or is very popular with local authorities. The federal government very deliberately and on a large scale supports projects in the areas of digital economy and society, sustainable management and energy, innovative work environment, intelligent mobility, healthy living and civil security (Bundesministerium für Bildung und Forschung, 2017).

The anchor point of the high-tech and IT industry is the regional or local, national and international networking of science and business. Existing strengths are taken into account, the expansion is promoted and new offers in cooperation and interfaces to other industries are created. It is becoming increasingly difficult to differentiate clearly between the sectors and industries, since high-tech and IT are represented in economic and research areas and this will be reinforced in the future (Bundesministerium für Bildung und Forschung, 2017).

Examples from practice are above all the cross-sectoral subject areas, as well as university cooperation (cf. Education and medicine): robotics, sustainable mobility, environmental technology, renewable energy and resource efficiency, healthcare, life sciences, information and communication technology (ICT), green IT and intelligent Products (Ministerium für Wirtschaft, Arbeit und Wohnungsbau Baden- Württemberg, 2017).

In that regard, the role of technology is advancing, as a natural process of development in general. And – consequently – the development of high tech solutions and products new technical approaches are being refined. One of those is recently becoming more dominant in urban planning: smart city (as defined in Chapter 3). Smart City developments aim towards technological solutions as job replacements and strategies for revitalization. Besides modifications of local governance and increased efficiency, they introduce technological applications to urban planning and cities (Schackmar et al. 2018).

Obviously not every city can be the next high tech centre or a new festival . It depends - as always- on the involved actors such as the location, citizen, political class and leaders, governance and other factors involved. As the urban context is complex, it is difficult to predict which strategy or project will be successful and which will not. It has also been investigated by Sorensen that a specific momentum might be needed in order to trigger a thriving project or strategy (Sorensen, 2016, p. 25f).

Despite that, the question arises whether smart city technology might bring around a new way to revitalise a shrinking city and strengthen them in many ways possible?

4 SMART CITIES

4.1 Identifying the smart city

With the advance of the concept of a smart city, a new promising solution in urban planning has emerged. A complex digital and intelligent solution has arisen. As a new problem-solving component, the smart city approach is a beacon of the ever-faster development in the digitalisation branch. Chicago, Boston, Hong Kong or Vienna, as prospering cities, have identified this as a chance to become more resilient in the global competition among cities. Somewhat ‘future proofed’ in an ever-changing world, but these cities are not nor were effected and dominated by the shrinkage issues mentioned (Bundesinstitut für Bau-, Stadt- und Raumforschung, 2015; Schober, 2014, p.11f.).

Sophisticated technology has risen and been developed, especially during the last two centuries. Through the integration and use of those innovations in urban planning, it has changed and transformed our cities.

Furthermore, introduced technological applications to urban planning and consequently cities, technology has sustainably modified local governance as well as increased efficiency wherever possible (Goodman et al, 1999).

The term of a ‘smart city’ has emerged and is recently being used more frequently as a general leitmotiv for cities, as well as part of the discussion among urban and regional development models and planning in general (Vanolo, A, 2013). The term smart cities are widely being used and defined in literature but still has no specific character or universal definition, as there are many different ways to include or exclude certain applications or ways to it. Combined by overarching innovation processes of changing cities in a connected and intelligent way (Jakubowski, 2014; Angelidou 2014).

In the literature the term is defined by Osborne and Rose as being framed as an efficient, green and socially inclusive and technologically advanced city (Osborne, T et al., 1999).

Others like Caragliu, Del Bo and Nijkamp have characterized smart city as including a networked infrastructure to achieve social, cultural and urban inclusion as well as social and environmental sustainability with a focus on including urban residents in public services (Caragliu et al, 2011).

A more recent attempt on defining what elements smart city could foster was published in the ISOCARP Review 2017, determining four pillars– sustainability, efficiency, people and security – of smart city. Those pillars include the subthemes of combined natures (Isocarp Review- Smart Communities, 2017).

Contemplating the term smart city from a practical perspective, it comes clear that it is used by many cities as an advertising element in city branding. Used as a so called buzzword to illustrate sustainable urban development, not necessary defining or interpretation smart city as well but rather use it in the sense that resilience and sustainability have been used before for marketing purposes and to take zeitgeist action and plans into account (Batty et.al., 2012, p.481; Colding and Barthel, 2017).

Narrowing the termini down to what it could encompass is, as depicted, a rather difficult approach- due to the fact that different authors as well as institutions in theory as well as practice are having different opinions about the term and how it should be defined.

Interestingly, even though to the fact that the number of literature publications, dealing with smart cities, has increased over the last 15 years, from about a dozen in 2005 to over 2000 in 2016 (Colding and Barthel, 2017).

In technical terms smart city is the intelligent management of digital data, networking in real-time and analysing data of various sources to create knowledge with new links of data to find answers (Libbe, 2018). The overarching tenor is though that intelligent networking technology is revolutionizing the way cities will look and function in the future, resulting in different urban planning approaches today. Specifically in the way that will enhance the effectiveness of city governance with the help of smart city technology interacting with citizens in so-called feedback loops. Made possible by sensors, digital communication and processing (Zanella et al., 2014, p.22).

With smart city applications, scale becomes less of a problem since it is easy to make most applications fit different city scales and (re-) development goals (Rager, 2019). Furthermore, a smart city is known for its ability to be “responsive”. This means that in contrast to usual measures undertaken in urban planning, such as the construction of physical infrastructure like roads that can not changed or adapted quickly and easily without spending resources, a responsive feature will be able to react to changes with much less effort. For that matter (Bundesinstitut für Bau-, Stadt- und Raumforschung, 2015, p.7). This quality contrasts the usual toolbox of urban planning which is rather static once implemented in the built up environment. Responsive features could make a real difference when it comes to engaging the rather fast and hard to predict challenges in shrinking cities.

In conclusion, there is none exact definition of what a smart city is and what it isn't, rather an agglomeration of aspects that overlap the different approaches to finding a definition. Overarching and rather unspecific are the general leitmotivs of a sustainable, resilient and environmentally friendly town. More accurate this includes the definition of smart cities being on the forefront of technological advance by connecting governance systems, public and social infrastructure with digital and intelligent technology and but also includes its citizens of being aware and self- decisive in being consumers and data sources to increase the overall efficiency of a city.

On a critical note, smart city being often used in close proximity with resilience the question arises, that with being dependent on technology on such a higher smart city level, dependence on functioning technology as well as cybersecurity become pressing. Can a smart city be resilient?

4.2 Smart city revitalization approaches

Especially shrinking cities, urban spaces in despair and disadvantaged cities as a whole are looking for ways to revitalise themselves. Find a road to stabilize population numbers and find ways to regrow the local economy. The Hi-Tech and IT industry presents itself to cater to those needs (see Chapter 2.3). Especially with the profit from the positive aspects of technological advance in terms of smart city products and strategies, this seems like the way forward.

Experimentation grounds for new smart city technology can be found in these rather difficult individual circumstances since every city has a different reason for shrinkage related problems. As these cities are actively trying to shape a better future for themselves, they are willing to go the extra mile and use many state-of-the-art instruments to reinvent. Job creation seems to be one of the highest priorities, since some other approaches such as culture lead regeneration have not always been as successful as planned, in economic terms (Schackmar et al., 2018).

This could be partly because of the project's nature and partly because the measures were not fitting the scale of the problems (Bundesinstitut für Bau-, Stadt- und Raumforschung, 2015). This quality contrasts the usual toolbox of urban planning which is rather static once implemented. Responsive features could make a real difference when it comes to engaging the challenges in shrinking cities.

In that regard, smart cities are linked very closely to digitalisation in general. Resulting in difficulties to know where exactly draw the line between a smart city project and 'just' a digitalisation or technological project in a city. As smart city projects are information and communication technologies that are somewhat intelligent, they aim not only at new solutions to problems but also to enhance the quality of life (Libbe, 2018).

This could be achieved not only by providing new jobs for residents in future-oriented economic branches but also by marketing the city, its workforce and its economic potential by actively changing the output prerequisites using smart city solutions. This usually is initiated and managed by the city administration. Bottom-up initiatives can ignite such a process in local politics but to work in an entire city this can only be managed by a city (Libbe, 2018; Batty et al., 2012).

This results in different possible actions to undertake for any city, not only shrinking ones, to become involved in becoming a smart city.

- New revitalization approach: Active business promotion, trying to attract and get smart city / high tech firms active in this resort to resettle to town in order, to generate new jobs and revitalise as well as push existing firms working in the field. Building on existing strengths.
- ‘Standard’ revitalization approach: Use smart city solutions to adapt existing revitalization strategies, as seen in chapter 2.3 and put the four pillars of sustainability, efficiency people and security in terms of smart city strategies forward

The City of Bochum, Germany and the City of Cincinnati, Ohio, USA have chosen to become smart cities amongst other initiatives due to similar initial settings of structural change and population decline. Depicting their efforts in doing so it comes clear that both cities have different approaches in doing so. Bochum is pursuing a rather active business promotion whereas Cincinnati is using smart city strategies to adapt existing revitalization approaches.

4.3 City of Bochum, Germany

The City of Bochum is located in mid-western Germany’s agglomeration of cities called Ruhrgebiet. A former center for coal and steel production as well as the manufacturing industry in the State of North rhine Westphalia. Having endured structural socioeconomic change over the last decades, many initiatives and strategies have been proposed and implemented in the past as well as the present (Stadt Bochum, 2018; Regionalverband Ruhr, 2013).

The most concise problems in Bochum are the development of its population over the last decades, the economic change, spatial challenges, infrastructure and mobility, city finance, social problems and housing among others.

The population reached an all-time high in the 1970s at around 435.000 inhabitants and has declined ever since to around 365.000 in 2015, due to a bad economy. In the last couple of years, it seems that it has been stabilized and is not shrinking anymore, even rising a bit. This Goal has been on the agenda of urban politics for years. At the same time, the economy was stabilising (Peuling, 2017).

Strategies for the economic turnaround have been implemented by the city administration since the coal and steel industries shut down, but especially since the late 2000s, when Opel and Nokia, as the city’s biggest (manufacturing) employers, have cut jobs and eventually have closed their company branch in Bochum. The city has initiated a strategy among others on the former premises of Opel, to create new jobs and attract new companies with future-oriented business. Today an industrial park called “Bochum Perspektive 2022” has been established. A range of firms have chosen to settle here, like High Tech Start-Ups, a Technology Campus of the Ruhr-University, Cybertech companies and branches of bigger companies engaging in research and development here (Terpitz, 2018). The “Strategy Bochum 2030” is taking matters to a coordinated citywide level with

As a city in a very dense metropolitan area, that wants to become a smart city region and is pressing for Ruhrgebiet cities to become smart cities, the smart city goal of Bochum, becoming the first “gigabit city”, where every citizen has access to a fast internet connection. Furthermore, it aims at becoming a center for Start-Ups companies and firms working in developing smart city hard- and software. Mirroring the fields and areas of living, housing, working and mobility as well as IT- security (WAZ, 2018).

Bochum is building on existing strengths with its strategies to promote and foster firms working in the field of smart city (technology) and further connecting them with strong links to education institutes. The city is home to nine universities with 60.000 students and adjacent researchers and today the biggest employer in town (RUB, 2020). Connecting this potential further to existing economic branches creates potential. Part of

the active business promotion is the competence of firms working in IT-security and the digital communication sector in general (Eiskirch, 2019; Bochum Wirtschaftsentwicklung, 2020).

The city can offer many, economic change brownfields as an incentive for industry or start-up companies to stay in the metropolitan region or to relocate. The current situation is “overall good,” according to a study of the Institut der deutschen Wirtschaft (Institute of German Economy) (WAZ, 2018).

Linking and supporting these close ties has led to a generation of new jobs and revitalise as well as push existing firms working in the field. The latest numbers of 2019 confirm the success of this approach. 2.500 new jobs were created in future-oriented branches in 2018. Regarding the digital communication and IT-security branch, 800-1200 jobs have been set up (Bochum Wirtschaftsentwicklung, 2019).

In summary, Bochum is pursuing a strategy to become a smart city- both in terms of being smart as in an infrastructural focused smart city but also taking advantage of the smartness that already exists in the city with its educational institutions and adjacent industries. Resulting in strategies to strengthen this position and productive links, as part of the smart city initiatives to support Start-Ups and related enterprises operating in the field of smart city tech.

4.4 City of Cincinnati, Ohio, USA

The City of Cincinnati is pursuing a different approach to become a smart city and push revitalization forward, even though the initial situation was not that different than in Bochum.

Located in the State of Ohio, Cincinnati is at the edge of the former coal, steel and manufacturing industries center of the US, called infamously rustbelt today. The rustbelt in general but also the City of Cincinnati in particular have largely suffered from socioeconomic decline and accompanying population loss, increasing numbers of declining property (values) and abandoned properties (City of Cincinnati, 2017, Mallach and Brachmann, 2010).

The City of Cincinnati has lost population since the 1950s peak number of citizens and has not recovered to its previous population. The population declined from an estimated 504.000 in 1950 to 296,020 in 2011. Since then the number of the citizen has stabilized and grown again to about 302.605 people in 2018 (World Population Review, 2020). The natural population development though is, unlike most other rustbelt cities, positive with a higher average fertility rate. Resulting in positive population growth, but not outnumbering the losses of migration during the period of decline (Stone, 2018).

The strategies of the past were rather scattered and not connected by overarching strategies and coordination. Attempts undertaken during the 2000s have been much more comprehensive and are successfully targeting issues and initiating revitalization (City of Cincinnati, 2017, Mallach and Brachmann, 2010).

The way Cincinnati is regenerating itself is a unique mix of comprehensive planning and outsourcing of political constraint decisions. For example, after years of decline the old urban neighbourhood of Over-the-Rhine was called the “most dangerous neighbourhood in the USA” (Woodard, 2016) in 2009. The city then decided to take matters to an experimental stage of outsourcing revitalization in terms of planning and economy to a corporate-funded and private entity, the Cincinnati Center City Development Corp. Today, it seems this worked out to be a best-case example of public-private partnerships: The neighbourhood is not only gaining residents, stopped shrinking and is a tourism destination due to architectural heritage (Anchor District Council, 2020; Woodard, 2016).

With the state capital of Ohio, Columbus, having successfully applied for a national smart city grant on transportation, Cincinnati is seeking to become a smart city as well and has embedded this goal into city politics, since local competition between the two is high (Pyzyk, 2019).

Today, the city has a comprehensive strategy to become a smart city. Mainly focusing on the goal to become the “smartest” municipal administration nationwide and therefore become more (cost) efficient, to become more competitive as a city and furthermore involve and engage citizens better through bottom-up participation (City of Cincinnati, 2017; Pyzyk, 2019).

To complement the already successful revitalization of Over-the-Rhine the city is rolling out a free Wi-Fi Project, connecting the CBD with Over-the-Rhine along a public transport corridor. This will enhance the efforts to further grow the economy sustainably within this part of town to foster engagement in the cities

society and bridge the digital divide. With this effort, the city looks specifically at how smart city technology can be used and installed to help the disadvantaged communities first (Pyzyk, 2019).

Other projects include the upgrade of infrastructure when necessary anyway to smart infrastructure. Using Smart Sewers and meters to save costs in the long run and to better predict maintenance. Moreover, the digitalization of city services leads to new possibilities like the “Fix it Cincy! app” where residents can submit service requests directly to the city works. This is working well especially in neighbourhoods with derelict infrastructure or poor maintenance, due to shrinkage processes in the past, to highlight areas in need of public attention. The open data strategy of the city is one key to becoming a truly smart city, with an open data portal providing transparency to all data collected and all analysis resulting (City of Cincinnati, 2017; Maddox, 2017).

Through projects like that, Cincinnati is using smart city strategies to adapt to existing revitalization approaches. To reach its goal, to produce better public services and implement better (digital) communication for citizens. Furthermore, the improvement of public safety as well as public health has been a goal (Maddox, 2017).

Concluding, Cincinnati pursues a path of re-growth after deep-decline, both economically and population-wise, with a mix of public-private partnerships and complementing smart city strategies. Structural blighted neighbourhoods are being revitalized as well as city administration “smartened” up to increase overall efficiency.

5 CONCLUSION

Ways forward for Smart Cities in Shrinking Cities are the strategies and approaches of the case studies municipalities, which contribute to the revitalization of these (shrinking) cities. It can learn from these historical developments that monostructural economic structures in municipalities create difficult situations when this economic sector is in a crisis. Resulting in the socio-economic structural change, where emigration has consequences for the town and all residents.

However, urban planning and development have always been subject to constant change and are constantly faced with new challenges. Because of this, there are always new challenges and impacts that must be taken into account when recruiting and locating replacement industries and the consequences of which for the urban environment are often still unknown. There is no guarantee of successful revitalization. The digital revolution in terms of smart city is an example in the case study cities of a rather positive nature, the positive effects have outweighed the negative ones.

From the experiences of the briefly presented city examples, it can be concluded that there is no clear answer to what a smart city is and what kind of initiatives there can be involving a smart city. As well as that there are many ways to include smart city aspects in urban politics.

A step in the right direction for Bochum and Cincinnati to push further revitalization including smart city developments to provide the ongoing or new revitalization initiatives or strategies with new energy. The adaptability or scalability of different smart city approaches comes to an advantage for cities with limited resources such as shrinking cities are.

However, at the same time, not every municipality has the same conditions and potential and therefore cannot rely on the same strategy, like Bochum with its smart city companies. The market potential for each industry is limited and once established somewhere an attempt to locate or create it somewhere else would be less successful. Also critically viewed must be the Cincinnati's approach to outsourcing revitalization to a public-private partnership as urban planning is then out of the cities immediate control.

Furthermore, on a critical note, smart city being often used in close proximity with resilience the question arises, dependence on functioning technology as well as cybersecurity become pressing. Can a smart city be resilient? And what does it take for it to be? Also, the dependence on public subsidies or private firms can be crucial to projects being initiated but it's not clear whether the city remains in control.

Another lesson learned is that the case study cities are not shrinking anymore but due to the long-lasting (negative) effects of decline one must still speak of shrinking cities to explain the range of issues at hand.

Concluding the paper, it has to be stated that structural economic change never stops. Replacing the old coal and steel mining structures with more modern technologies is not a one-time affair. The technological race is constantly changing and so is the one at the top.

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