Support of startup innovation towards development of new industries

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Abstract

Many regions have been dominated by industry in the past. Due to the changes driven by digital transformation, former industry-driven regions need new ideas, products and services in order to keep the local economy stable or even to expand it. Addressing both economic and societal challenges can be supported by strengthening local innovation. Startups are important engines for innovation. But they only can grow if embedded in a perfect functioning startup ecosystems. This study aims at demonstrating how local startup-support programs can help increase innovation in former industry-driven regions and how new economies can emerge out of it.

1. Problem statement and overall objective

Many regions are specialized in certain industries for different reasons. This focus and concentration on one topic brings locational advantages that regions with mixed industrial topics do not have. As long as this industry is successful, the regions benefit economically, socially and politically. However, it becomes difficult when certain branches of industry die off or are replaced by others.

The world is changing, new ideas are emerging at all times that make new technologies possible and produce innovative products and services. "We are currently experiencing a phase of rapid technological innovation that is transforming our world sustainably. The end of this development is not yet in sight. [...] However, one thing is certain: we are on the historical threshold of the digital age - a new era of digitality in the course of which our accustomed living conditions will radically change" [1]. This new epoch of digitality, known under the term "digital transformation" [3, 8, 9], cannot be avoided by anyone. "Digitization stands for the complete networking of all sectors of the economy and society, as well as the ability to collect relevant information, and to analyze and translate that information into actions. The changes bring advantages and opportunities, but they also create completely new challenges"[3]. Accordingly, digital transformation has an impact on all industries. This, in turn, can affect entire cities. "DT describes the fundamental transformation of the entire business world through the establishment of new technologies based on the internet with a fundamental impact on society as a whole" [8, 9].

In order to do justice to this transformation into the digital age, cities and industries must invest in new ideas, products, services and business models. The best strategy of an industrial region to secure such long-term innovations is to support new ideas. One of the most effective innovators and creators of new ideas are startups [2, 7, 9]. "Startup companies are newly born companies which struggle for existence. These entities are mostly formed based on brilliant ideas and grow to succeed. These phenomena are mentioned in the literature of management, organization, and entrepreneurship theories. However, a clear picture of these entities is not available" [6].

By supporting local, innovative startups, new companies can be developed, existing product ideas expanded and the entire economic system strengthened, which is reflected, for example, in the creation of new jobs or the filing of patents [2, 4, 10].

The hypothesis of this work is that industrial regions must not be satisfied with their temporary success, but must invest
early in disruptive innovations in order to position themselves optimally for the future. Startups are an effective way to generate innovations. The research group presents in this paper the performed research study aiming at validate the above stated hypothesis by applying an innovative research methodology presented in the next paragraph.

2. Research Methodology

The research group has planned a study in four phases. The four phases are defined in Table 1:

- **Phase I: Preliminary study**: Study of several cities in a few large industrial regions with regard to known product innovations.
- **Phase II: Reflection Study**: The regions shall be investigated again in a reflective way. The study criteria will be improved and new findings will be included.
- **Phase III: Internationalization**: After new criteria have been established and old criteria refined, the study shall be repeated in several international industrial regions.
- **Phase IV: Validation, refinement and final conclusion** are planned. Publication [5].

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<td>Phase I</td>
<td>Investigation of several cities in few industrial regions.</td>
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The research group presents in this paper the application of the methodology by starting and highlighting the results of the Phase I, as detailed below.

3. Phase I study and preliminary results overview

3.1. Phase I: Study Overview

In Phase I of the study, five cities in two industrial regions have been examined from an economic-historical perspective in order to identify positive and negative developments and to outline success through innovation. The terms "innovation" and "startup" are characterized as follows: Innovation cannot be planned, but measures can be taken to support innovation efforts. Startups [2, 4, 6, 7, 10] are the most important carriers of innovative ideas for cities and municipalities. “Startup companies represent a powerful engine of open innovation processes” [10]. In order to have any chance of establishing themselves on the market, startups must have an innovative business model. „Unlike large companies, startups find it difficult to use traditional business planning, the premise of which is that future results - based on the analysis of past experiences - can be extrapolated, because there is no past experience in a startup besides the uncertainty of its essentially innovative nature” [2, 4, 7]. They are the innovators of the future. The safest strategy for a city and its industry to secure long-term innovation is to support local startups. In order to ensure long-term economic success, cities must also increase their commitment to support startup. If a city really wants to be smart and innovative, it must support startups today in order to be able to establish innovations in its own city tomorrow. A city in which many startups are supported and founded has sufficient first-hand opportunities to implement innovations directly. For these innovation resources to be exploited sustainably, cities must work to provide the best possible breeding ground for innovations. In order to make innovations possible, it must be made sure that new ideas are embedded in the best available environment for rapid testing, instant feedback, and great ideas [10]. Only those who incorporate novel ideas and technologies into their city and industry are on their way to transform to the digital age and startups guarantee these innovations [8, 10]. Thus, a city and its industry needs to support startup activities.

3.2. Research Outputs

In both regions, different cities have reacted differently to the paradigm shift. The following examples show how the successful cities have been able to make a positive change by investing in innovation, especially through support and cooperation with startups, and how they have optimally prepared for the transformation into the digital age, while other cities have missed this development and are thus facing major economic, social and political problems. In addition, a look had been taken at some formerly very successful companies that missed the paradigm shift and were therefore completely or partially driven out of the market by other companies.

3.2.1. Rust Belt (USA)

The Rust Belt is the oldest and largest industrial region in the USA. This industrial region stretches over the northeast of the USA and was characterized by heavy industry, iron, coal and steel in the 20th century. In the 1960s, the economic importance of the region declined rapidly due to the migration of heavy industry to cheaper producing developing countries. In addition, mining jobs disappeared.

The subsequent structural change had different regional effects: Some cities attracted technology and service companies, in which numerous new jobs had been created, other regions lost a large part of their population and are still characterised by high unemployment, crime and urban decay [11].

**Pittsburgh**: Pittsburgh is a prime example of successful
structural change. The former steel capital, long a symbol of the decline of the Rust Belt, is now developing into a pulsating centre for companies in the fields of artificial intelligence, robotics and biomedicine [13].

After the steel crisis in the 1970s, Pittsburgh was marked by economic decline. Many industrial jobs were lost and the city lost more than half of its population between 1950 and 2010 [31]. After the decline of the steel industry, CEOs, university directors and politicians joined forces to raise money for the conversion of factories and retraining [29]. In addition, support programs were set up for young entrepreneurs. This shifted the city's economic base in the late 20th century to education and services, much of which were high-tech, and numerous startups were founded [19, 30].

In 2016, the Pittsburgh metropolitan region was one of the economically strongest metropolitan areas in the USA. The unemployment rate was below average and most employees now work in the service sector. Pittsburgh is home to five universities, of which the Carnegie Mellon University and the University of Pittsburgh are internationally renowned. Google, Apple, Facebook and Uber are among the 1,600 technology companies in Pittsburgh today [30].

**Detroit:** While the former steel capital Pittsburgh has been revived, the former car capital Detroit has got stuck in its old structures, with no visions for new ideas and is still suffering from the decline of heavy industry and the structural change of the car industry.

Through the activities of numerous American car pioneers in the first half of the 20th century, Detroit rose to become the leading location for the US automobile industry and, as a result of the boom in this industry, became the fourth largest city in the nation for a time. In the 1950s, Detroit reached 1.8 million inhabitants [18].

Since the big three automobile companies - General Motors, Ford and Chrysler - underestimated the competition from Japan and Europe and the oil crisis of the 1970s also caused a rupture, the automobile capital Detroit slowly declined. The automobile industry relocated, factories had to close and unemployment skyrocketed [23].

Detroit suffered such massive migration losses that its population fell below one million by 2000 and continued to fall below 700,000 by 2014 after Detroit became the first US city of this size to file for bankruptcy in 2013 [21]. The city remains behind with a high proportion of people at risk of poverty, high crime rates and 78,000 abandoned buildings [27]. What is particularly problematic is that the well-trained and higher earners in particular are emigrating and finding jobs in other cities without any problems. As a result, less and less tax is paid, which leads to a further negative spiral.

### 3.2.2. Ruhrgebiet (Germany)

With 5.1 million inhabitants, the Ruhrgebiet is the largest conurbation in Germany and the fifth largest in Europe. Coal mining in the course of industrialization led to economic expansion in the Ruhrgebiet, which necessitated the recruitment of new workers. Due to immigration from other parts of Germany and an above-average birth rate, the population grew explosively. The coal and steel industry dominated the Ruhrgebiet. In the 1950s, 500,000 people were employed in mining. However, with the first coal crises the number of jobs halved by the end of the 1960s [15].

In the 1970s, the change towards a service society began. This structural change took place in the Ruhrgebiet later than in most other regions due to the great importance of the coal and steel industry. With the decline of coal and steel in the Ruhrgebiet, an upheaval set in that has not yet been completed. The north migration of coal mining affected the northern Ruhrgebiet in particular. There is still an above-average unemployment rate, higher income poverty and a lower level of education.

**Gelsenkirchen:** An example for a negative development is Gelsenkirchen from the northern Ruhrgebiet. While 400,000 people lived here in the 1960s, today there are only 260,000 and there is a high level of poverty. The number of jobs has fallen by more than half as a result of the steel and coal crisis. The Gelsenkirchen employment office district has the highest unemployment rate in North Rhine-Westphalia with 14 percent [14]. There are abandoned industrial sites, urban sprawl and no clear local structures. Many qualified people migrate to other regions. Between 2008 and 2014 the proportion of Gelsenkirchen's population with a high level of education (master's, technician's, university degree) fell sharply from 24,000 to 18,000, but at the same time the proportion of people without any degree rose from 83,000 to 92,000 [24].

In the southern Ruhrgebiet, the loss of coal and steel has been compensated due to the establishment of universities and some successfully established technology centres. This has resulted in a new urban quality of life with high-quality services. All five universities in the Ruhrgebiet and the majority of research institutes, technology parks and business incubators are located in the south. This leads to a migration of highly qualified people, which further increases the north-south divide [15].

**Essen:** As a counter-example from the South, Essen has largely mastered the changes. In recent years, Essen has increased its gross national product more strongly than Cologne and Munich and is home to several corporate headquarters [17]. The University of Essen is one of the ten largest in Germany and with a total of 14 funding programs, Essen ranks first among the top startup funding cities in the

![Fig 1. Development of the number of employees in hard coal mining, Ruhrgebiet 1950-2016, Source: WWF [15]](image-url)
Ruhrgebiet. As a result, Essen’s business registrations are far above the NRW average and the Ruhrgebiet’s Digital Hub Initiative Location is based in Essen [25]. Essen became the European Capital of Culture in 2010 and the Green Capital of Europe in 2017.

**Bochum:** Another very interesting example is Bochum, which had even experienced two waves of ascent and descent within a short time. Here, at the beginning of the coal crisis over 40,000 people were employed in the coal industry [22]. With the closure of most of the plants at the beginning of the 1960s, the upheaval of the city began with the founding of the Ruhr University and the establishment of Opel in Bochum. For Bochum, the construction of Opel’s factory was a stroke of luck, but instead of developing other industries, the city again entered a form of dependency focusing on only two big players. At peak times, Opel employed 22,000 people in Bochum [20]. Further jobs were later created by the Nokia factory in Bochum. At times more than 4,500 people were employed there and Nokia was the largest industrial employer in Bochum after Opel [26]. Although Nokia received many millions of euros in subsidies for structural change, the Finnish mobile phone manufacturer shut down its factory in Bochum in 2008. After this setback, Opel also announced in 2014 that they would cease vehicle production in Bochum and that thousands more people would lose their jobs [26, 28]. In order to push ahead with the structural change, Bochum started to invest in startups instead of sheet steel. With 70 million euros in subsidies and a new technology campus on the former Opel site, new industries and jobs are to be created [22]. The Centre for Science, Technology and Business Startups of the Ruhr-Universität is to warm students up for the idea. "Bochum used to be a coal city, then an Opel city, but now it’s becoming a city of knowledge” [28]. Instead of 60,000 coal workers, there are 60,000 students today [28].

The Ruhr-Universität Bochum has been included in the Excellence Startup Center NRW program with a total of 150 million euros for the promotion of startup culture [12].

### 3.2.3. Analogies for companies

In both the Ruhrgebiet and the Rust Belt, regions that invested early in the development of new, innovative industries are more successful than those which have long held on to the boom industries of the early 20th century. The example of Nokia shows that this behavior can also be transferred to companies. The Finnish company, which was the market leader for mobile phones from 1998 to 2011, has missed the mark and focused almost exclusively on improving production processes rather than on developing new digital products. Touchscreen smartphones were not an issue for Nokia at first. Subsequently, Nokia was replaced by Apple as market leader and after further declines in production, the mobile division was sold to Microsoft in 2014 [18].

Kodak is another example of how companies that do not invest early in new, innovative products lose their long-term success. Kodak invented the photographic film and has made huge profits over decades. After Kodak developed the first digital camera in 1975 - long before its competitors - Kodak decided not to market so as not to jeopardize its photo film business. Thus, Kodak missed the opportunity to be at the forefront of innovation out of supposed consideration for current profits. In 2011, the former pioneer posted a loss of more than 230 million US dollars and filed for bankruptcy just one year later [32].

In 1957, the mail-order company Quelle prevented its failure with an innovation. By building a more efficient shipping facility, the company had the most modern parcel factory in the world and was able to ship 100,000 parcels a day. However, Quelle also rested too long on its success, because although the American startup Amazon was able to offer significantly cheaper goods in 1994 by selling goods via the Internet, Quelle did not switch to the innovative online booking and distribution system in time. Although the department store later tried to enter the online market, it had to admit defeat in 2009. As a result, this established company also failed in the digitalization process [32].

### 4. Conclusions and Next Steps

The research group examined five cities in two industrial regions in the USA and Germany and found that technological progress requires industries to establish new innovative products, services and business models in order to remain competitive in the market [6]. The German Ruhrgebiet and the American Rust Belt were two of the most important industrial regions of the early 20th century. In both regions, structural shifts between the industrial and service sectors led to an increase in unemployment and a decrease in the value added of the industrial sector.

In both regions, this structural change had different regional effects, so that some regions have already recovered and experienced a new upswing, while other regions are still marked by consequences of structural change, such as high unemployment and urban decay.

The common features of the successfully transformed cities of Pittsburgh, Essen and Bochum are their prestigious universities and the development of new high-tech industries through the promotion of technology and startup centres, especially startups with a focus on the technology sector. The negative examples Detroit and Gelsenkirchen have in common that they have held on to the boom industries of the early 20th century for too long and have not invested early in new, innovative industries. As a result, they were particularly hard hit by the decline of the old boom industries and the decay of large local corporations, as well as the brain drain. This behavior can also be observed in incumbents. Companies that do not invest early in innovative products and services cannot guarantee long-term success. In the cities of Essen, Bochum and Pittsburgh surveyed, it can be seen that, on the
one hand, increased cooperation with universities has led to an economic upturn and, on the other, the support and establishment of startups in these industrial regions has provided the necessary innovations. The negative examples Detroit and Gelsenkirchen leave out precisely these cooperations with universities and startup centres, and thus cannot detect any increase in innovations in their industrial regions. These cities did not live up to the claim of carrying out a digital transformation. "The digital transformation of our time is experienced by many people as a revolution that befalls us like an uncontrollable natural disaster. [...] Although it is difficult to keep track of the complex dynamics of development, we can actively influence these thrusts through our actions" [1]. The only way to successfully influence this complex development dynamic is to strengthen the innovative power of an industrial region. The digital age, with all its rapid technological innovations, is also an opportunity for industry. It is the challenge to establish new innovations as fixed components of an economy and to work early on the development of the next innovation. Industrial regions must become aware of this development of innovations and prepare themselves in good time to promote innovations themselves. The most effective way to promote innovation in a city and its industry is to support startups in this region [7, 10], and to provide optimal conditions for their startups. Startups must have an innovative product, service or business model in order to compete in the market [2, 4]. A city, but also individual companies, have different possibilities to promote and support startups, e.g. by opening startup centers, running accelerator programs or providing experts as mentors who help the startups to develop their innovation and anchor it in the already existing industry. For these innovation resources to be used sustainably, cities, regions and companies must work to create the best possible breeding ground for innovation. As stated before: It is not possible to plan innovation, but you can ensure that it is embedded in the best available environment to guarantee rapid testing, instant feedback and great ideas. Only those who bring new ideas and technologies into their own structures are on the way to digital transformation and startups guarantee these necessary innovations [2, 7, 9]. An industrial region must therefore support startup activities in order to carry out this transformation. In any case, however, industries must begin to change the strategies of their companies in order to do justice to the change towards innovative management. It should be stressed that the implementation of a strategy always has long-term and short-term consequences. A radical corporate restructuring can result in short-term losses, but can achieve long-term success if the strategy is successful. The restructuring of an industry does not happen overnight. In view of the path of transformation that lies ahead of the industries, the demand for returns must not be unconditional. It must be borne in mind that every euro has to be invested in digital transformation in order to be prepared for the future. This is where investment is needed first, not return. Some industries have understood this, others are no longer allowed to wait. All that remains is to emphasize that investment in startups is the best way for industries to meet the challenge of digital transformation and anchor innovations in their own cities and industries [2, 4, 8, 9].

The next steps of the research group are described in paragraph 2. In Phase II, the research criteria will be improved. In Phase III, a new study will be carried out on an international scale. In phase IV, the summary, conclusion and publication of the overall study is planned.

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