A Holistic Approach to Understand Urban Complexity

A Case Study Analysis of New York City

Dominik Kalisch[1(✉)], Steffen Braun[2], and Alanus von Radecki[2]

[1] Saint Mary's College of California, Moraga, CA 94575, USA
dkalisch@stmarys-ca.edu
[2] Fraunhofer-Institute for Industrial Engineering IAO, 70569 Stuttgart, Germany
{steffen.braun,alanus.radecki}@iao.fraunhofer.de

Abstract. In 2012, the Fraunhofer Society, under the leadership of the Fraunhofer Institute for Industrial Engineering, started an ambitious innovation network project called Morgenstadt: CityInsights. For this system research initiative, 12 Fraunhofer institutes worked together to analyze innovative solutions in six different cities around the globe for a sustainable city. The goal of this project was to understand the city in a holistic way, applying the approach of system engineering to the field of urban development, as well as to identify the key factors to redesign existing and newly emerging cities in a more sustainable way. In this paper we will describe a systematic and holistic approach in city analysis and illustrate initial sector-related results of the on-site research in New York City in 2013. We will further analyze project and process structures of the studied projects and describe what other cities can learn from New York City. We complete the paper with an outlook on the second project phase that started earlier this year.

1 Introduction

According to the United Nations (United Nations 2012), 60 % of the world's population will live in urban areas by 2030. While many cities around the world are growing and expanding, at the same time a large number of cities in the northern hemisphere are facing reverse trends, e.g., caused by the demographic change. As a result of these trends and the comprehensive globalization, cities are competing within a global market for companies and well-educated inhabitants. As an additional challenge, the climate change revealed his powerful forces during the last decades as seen in hurricanes Katrina and Sandy in 2005 and 2012, respectively, or typhoon Haiyan in 2013. In this context, cities are facing an extremely difficult assignment: an innovative sustainable development of the city, including ecologic, economic and social dimensions. This task includes two central requirements, making the city livable on the one hand and resilient against external factors such as natural disasters or other crises on the other. This paper outlines innovative approaches in New York City in order to achieve

A. Hameurlain et al. (Eds.): TLDKS XXVII, LNCS 9860, pp. 31–47, 2016.
DOI: 10.1007/978-3-662-53416-8_3

the goal of a sustainable city of tomorrow. The paper is based on an interdisciplinary long-term research project called "Morgenstadt: City Insights" (M:CI), which analyzed innovative and sustainable solutions and projects of the city sectors mobility, water infrastructure, production and logistics, governance, buildings, energy, security and ICT in six leading cities around the world in order to identify common characteristics and structures of success stories. Therefore, the paper first presents the research methodology of the M:CI project, followed by an overview of the examined sectors, projects and cities. Subsequently, the key findings regarding the examined sectors in New York City will be presented and the role of each sector for an innovative and sustainable city development will be outlined. Finally, the paper discusses the transferability of the identified approaches and tries to illustrate possible strategies to implement such innovative and sustainable solutions.

2 Morgenstadt: City Insights Project

The following section of the paper provides a brief introduction into the M:CI project. First the underlying idea for the project is outlined, followed by the developed and applied research methodology.

2.1 Idea

The urban knowledge economy is facing a tremendous transformation that will affect the society technologically, organizationally and systemically. Individual technological sectors, such as energy or mobility, will be affected. But since these sectors are highly cross linked, especially in cities and urban regions, the change in one sector will affect all others as well as the urban system itself. To understand the interdependent links between the urban sectors, the Fraunhofer Society launched the innovation network M:CI. For this system research initiative, 12 Fraunhofer institutes work together to investigate innovative solutions for a sustainable city. To achieve this goal a holistic research approach was developed in order to analyze the city system in its interdependent structure (Kalisch et al. 2013a). The main goal of the first period (2012–2013) of the M:CI project was to identify the status quo and establish a starting point for the research and development of innovations for urban systems. Based on the findings of the first period and the systemic understanding of urban areas, the second period (2014–2015) will focus on discovering and implementing systemic approaches that successfully respond to the increasing problems of the selected technology fields in leading cities. By detecting and analyzing innovative but already field-tested approaches, their feasibility for other complex environments and demands for an urban future will be evaluated. To verify this, expertise will be pooled to develop smart and individually customized strategies together with our network partners from industries and cities, aiming at the future requirements for further concepts' efficient implementation.

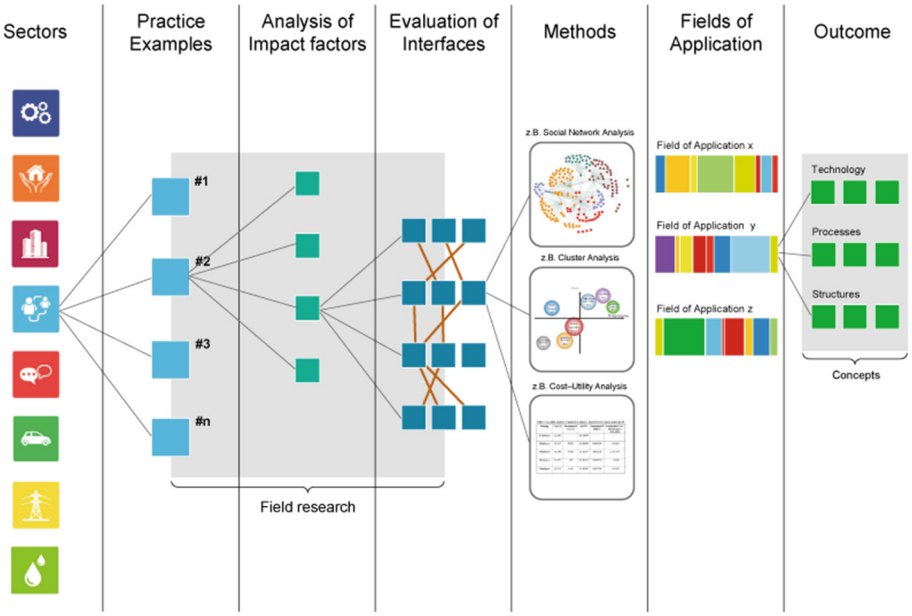

Fig. 1. Overview of the research process from sectors to areas of application (Kalisch et al. 2013a)

2.2 Methodology

The M:CI project follows a trans-disciplinary research approach; its first phase has been divided into seven phases (Fig. 1). At first more than 270 global good practices in more than 250 cities around the world that were applicable to bring the city forward towards a liveable, resilient, zero-waste and CO2 free city were studied. The examples were ranked by researchers from the corresponding field by innovative technologies, business models, forms of organization used, and the transferability to other cities. Based upon this assessment 80 solutions were defined as best practices. All 80 best practices were evaluated in a systemic way which included assessment of core sustainability indicators on social, economic and environmental impact and a cross-sectoral analysis of systemic interfaces with other sectors. The amount of identified best practices per city served as reference for the city ranking. Further, a meta-analysis of cities that appeared in different indices lists was conducted. Based on this list a meta-ranking of the cities was compiled that reflects their overall performance. The final ranking was realized by integrating the best practice-ranking (70 %) and the global meta-ranking (30 %) into one list of inspiring and leading global cities in the field of urban sustainability. The first 24 cities of the final ranking were taken as base items for defining the top 12 list. This was done by referring to the preferences of project partners, to a fair regional distribution and to a good distribution of sector-specific best practices. Based on the top 12 list, the project partners

chose six cities (Berlin, Copenhagen, Freiburg im Breisgau, New York, Singapore and Tokyo) that were studied on-site (phase 1 and 2 in Fig. 1). Prior to the two week research visit, the mayor's offices were contacted and asked to support the fieldwork with a letter of recommendation and support. Additionally several other locally-based institutions such as universities, German associations, etc. were also contacted in advance to request support in lining up interviews with the persons that were responsible for the studied best practice examples.

The M:CI project team defined 15–65 indicators with the associated data for each sector in the given city and saved this information in a relational database that was developed for this project (Kalisch and Wetzel 2013). The same was done with information and data that were collected from each studied practice example in the city. Prepared with the results of this desktop research, a group of Fraunhofer researchers stayed in each of the six cities for two weeks and mainly conducted narrative interviews with relevant actors within each practice example. The interviews, typically 1.5 h in duration, were conducted on the basis of a part standardized questionnaire which was adapted to each interview. The interviews were recorded, when permitted, and later analyzed. The practice examples were, whenever possible, viewed and visited, in order to gain a personal impression.

Each night the involved researchers came together to share the insights they gained during the day. This step was not only done for a group dynamic reason, but to gain trans-disciplinary insights from the other researchers. By sharing and discussing the experiences, the researchers were challenged to view the studied example within their own sector from another perspective and also to rethink the projects of other sectors from one's own perspective (see Roe 2012; Mille Bojer et al. 2008). Additionally, all actors that were involved in the city's key projects were invited to an evening event during which the project, as well as the researcher's first impressions of the city, were presented. The city's sustainability initiatives were discussed during a panel discussion and a subsequent reception. The feedback of the participants was incorporated in the analysis and accounted in the following interviews. During the so-called "Morgenstadt: City Labs" several hypotheses relating the examined practice examples were developed following a defined methodology and discussed with the M:CI project partners. The discussions served to help the researchers recognize inherent patterns in the implementation of projects and solution approaches (phase 3 and 4 in Fig. 1). Based on the qualitative interviews and available quantitative data, impact factors for certain processes were identified. The analysis of impact factors uncovers why a certain progress happens in a particular way in a specific urban system. Accordingly, they describe general forces that push or hinder the process of sustainable development on many different levels. The identification of impact factors is complex and requires a trans-disciplinary reflection by the researchers. The researchers therefore reflected every day on the identified drivers and framework conditions. One important tool for this was collaborative mind-maps to structure the identified factors. Further, a mixed methods approach was applied, utilizing social network analysis and cluster analysis (phase 5 and 6 in Fig. 1).

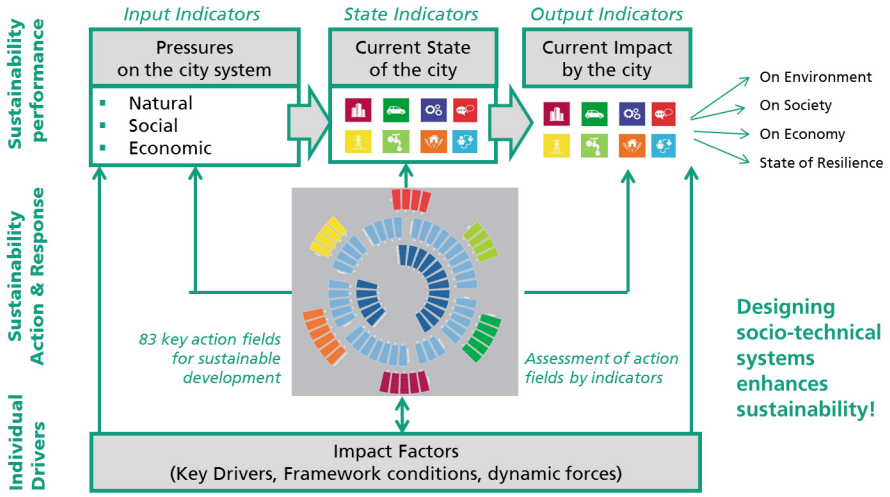

Fig. 2. Morgenstadt model for sustainable urban development (Fraunhofer IAO et al., 2013a, p. 211)

Starting from a three-level-approach (indicators, impact factors and action fields) of urban systems analysis, the M:CI research network developed a first generic model for sustainable urban development (see Fig. 2). After the on-site research visits, all prior defined indicators had been evaluated. The assessment showed that most variables are only available in some cities and therefore not useful for general city comparisons. A revision of the M:CI indicators provided a set of less than 100 urban indicators that define the state of sustainability of a city. These indicators are listed in the final project report (Fraunhofer Institute for Industrial Engineering IAO 2013). The 83 defined key action fields for sustainable development represent the core of the Morgenstadt model (Wendt et al., 2014). These action fields describe the sustainable actions and responses of the cities. They can be related to indicators and allow the M:CI researchers to assess whether a response of a city is in line with existing pressures or state conditions and therefore helps optimize outputs for enhanced sustainability. The key action fields were further assessed by the participating researchers. They rated the impact of each key action field on each other based on their field of expertise. This so called cross-impact matrix of key action fields was subsequently evaluated by the sum of active and passive ratings. By plotting the sums of each key action field, three groups of action fields could be separated that have a significant relevance for sustainable development of a city (see Fig. 3).

– The “drivers” were key action fields that bring ideas and initiatives forward.
– The “enabler” enables the city to perform certain actions.
– The “levers” amplify given actions.

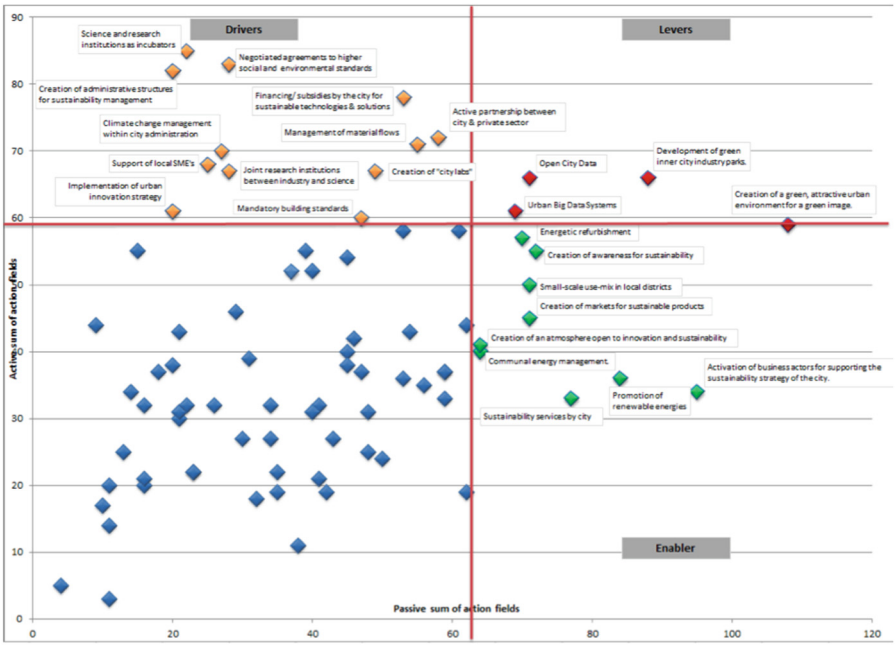

Fig. 3. Cross-impact analysis of key action fields (Wendt et al., 2014, p. 536)

The cross impact of each key action field to each other is also dynamically visualized and accessible for project members through the project website.

3 Sector Results

It has proven to be quite difficult to compare cities in terms of their sustainability and their projects designed to increase sustainability, as no uniform assessment criteria exist and because the framework conditions of each city are unique. This brings rise to the following: Is it even possible to learn from the experiences of individual cities?

The M:CI project argues that while every city with sustainability-oriented projects and approaches reacts to specific challenges, uses locally-available resources and implements its projects under local framework conditions, the main challenges addressed are, nevertheless, comparable to the challenges faced by many cities worldwide. The projects are planned and implemented according to similar patterns. As such, the objective of the M:CI project is to understand the activities within the individual cities, to identify the specific framework conditions present, and to recognize the patterns within these activities.

Thus, the M:CI research visits were conducted with the following objectives in mind:

- To analyze the selected practice examples in relation to their motivation, conception, planning, successful implementation and measurements of success;
- To identify the key drivers and framework conditions which have affected the projects and solution approaches either positively or negatively;
- To analyze the network of actors, their roles within the studied projects and their solution approaches;
- To discuss the transferability of projects and solution approaches to different cities.

For the Fraunhofer M:CI project six researchers visited New York City between April 8 and April 23, 2013 to conduct 50 interviews (Kalisch et al., 2013b) with experts, political leaders and scientists from the different sectors. The following results are a summary of the City Report for New York City (Kalisch et al., 2013b).

3.1 ICT

The cooperation between NYC's mayor and police chief has been a significant structural effect factor. The implementation of CompStat and the resulting revolutionized police work in NYC was possible thanks to former NYC mayor Rudolph W. Giuliani and former chief of police Bratton who jointly developed a strategy to improve safety in the city back in 1994. The mayor of a city has the ability to set comprehensive priorities and involve other relevant public authorities in the process; because of that, inter-dependencies with other sectors can be examined and modified if needed. Local differences in a city, and the corresponding adjustments required to adapt to individual circumstances and conditions in the various districts, pose another important factor for success. For example, in NYC local representatives are involved in the strategy formulation process for the city's police. An important part of the development of strategies and the implementation of locally adapted approaches in NYC are the CompStat meetings in which police chiefs meet with their key employees once a week to exchange knowledge on successful factors, identify existing barriers and discuss how to resolve these barriers in order to improve the city's overall anti-crime strategy. It must be ensured that such a strategy is continuously evolving and adapting in order to ensure that crucial exchange and learning is an ongoing process. Data analysis is central to the fight against crime in NYC. A continuous review of strategies and the results of procedures contribute to the ongoing evaluation of data. Information gathered on the location, time, and specifics of a crime, combined with details gathered on the offender(s), is evaluated to optimize the fight against crime. Timely evaluation is essential and effective evaluation can, for example, lead to more focused policing of certain identified areas and enhance adaptation to local conditions. Another important factor is to gain the support and involvement of the population in order to obtain information about crime in different neighborhoods. This has been achieved through community policing initiatives, which can also help to improve the relationship between the

public and the police. NYC's outcome-oriented approach has been a central factor contributing to the city's continued and dramatic reduction in crime rates. The focus here has not been on predicting individual crimes but on uncovering general patterns. This approach was successfully implemented to reduce auto theft in NYC.

3.2 Security[1]

Overall, NYC is promoting three key strategic security missions: catastrophe and disaster management, big data, and infrastructure protection. In the wake of Hurricane Sandy, NYC has undergone vital measures to better prepare for and respond to natural disasters and the short and long-term consequences thereof. Based on the successful implementation of PlaNYC, A stronger and More Resilient New York, a nearly US $20 billion resiliency plan, was implemented. This plan is a comprehensive endeavor to unite and concentrate the city's core capabilities in the field of sustainability with the aim of incorporating infrastructure and activities related to the built environment, such as coastal protection, insurance, utility supply, healthcare, water and transportation with specific community rebuilding efforts and resilience planning. The plan foresees the participation of not only official and professional bodies, but also New Yorkers themselves and therefore works to keep residents thoroughly informed on the various initiatives and projects announced in the plan. Hurricane Sandy hit NYC and the surrounding urban areas with such unexpected intensity that experts agree that the city and its neighbors have begun to reconsider the city's close proximity to the ocean and the threats that may occur due to its specific location. Thus, the NYC Office of Emergency Management (OEM) is revising all flood and security-related maps to better prepare for both natural disasters and man-made catastrophes. Big data systems are at the forefront of NYC's security strategy. The city's surveillance system, known as the Domain Awareness System (DAS), which was launched by the NYPD, provides an example of the city's interconnected big data systems. The DAS combines CCTV camera footage, reports from over 3,000 radiation sensors, license plate detectors and public data streams for the identification of threats on the streets. NYC has made it a priority to support crime prevention as well as crisis management operations using existing as well as new sensor and data systems which are based on the sharing of extremely large amounts of data. Such interoperable information gathering systems have become crucial to the work of all security-related authorities. Systems such as NYPD's DAS are designed to be transferable to other metropolitan areas which are equally densely populated and have a similar urban infrastructure. However, the cultural context in which such systems are placed is crucial for their implementation since they may interfere with civil and privacy rights causing controversies and a lack of acceptance among citizens. As a third fundamental security mission, NYC is on the forefront of critical infrastructure and building protection. The city is still deeply stricken by the

[1] This paragraph is co-authored by Hanna Leisz.

very recent consequences of Hurricane Sandy and the events of September 11 have left the city deeply scarred. The reconstruction of the World Trade Center as a key business district is strongly grounded in developing technological and emergency response-related security measures. In particular, site access control systems, above all the Vehicle Security Center, show that preparation for a possible terrorist attack is a core motivator of the overall security planning and implementation measures taken for both individual building complexes as well as surrounding interconnected infrastructure complexes in the corresponding city districts.

3.3 Water[2]

Since 1842 New York City has received water from outside the city's boundaries. Nowadays, more than 9 million inhabitants and visitors of the city are relying almost completely on water sources up to 250 km away from the city. Consequentially Mayor Bloomberg asked, as he came into office, "What could literally close down this city?" A failure of the supply system, transporting water into the city would have done that (Flegenheimer 2013). While the water supply infrastructure was aging, several droughts in the 1980s made the limitation of the water resources obvious. At the same time the population was and still is steadily growing. Due to these conditions, the city successfully started several strategic plans and initiated measures to achieve water conservation, to modernize the existing supply infrastructure, and to guarantee that the water resources will be sufficient for serving the population even in future times. While the city set up rules for water conservation, in one prominent district, the Battery Park City (BPC), even higher standards were developed by the local authorities, that have to be achieved for new buildings, leading to most innovative solutions in terms of water reuse and efficiency, decentralized waste water treatment, and energy efficiency within buildings. The practice examples of BPC are impressive showcases, presenting the water reuse and efficiency potential in combination with a high level of living quality in modern buildings within densely populated areas of a city. Increased awareness of the city's attractiveness brought the value of the many surface water bodies of the city more and more into focus in recent years. At the same time, more frequent flooding of an ever broader range of communities occurred, leading amongst others to regular combined sewer overflows (CSO) into the city's waterways. To prevent flooding and to avoid the pollution of the water bodies by CSOs, several strategic issues, such as the Sustainable Stormwater Management Plan, were incorporated within the city's strategic master plan, PlaNYC. The different issues NYC is confronted with in the water sector occur all over the world more and more often. The solutions of the city, the strategic processes targeting many small and larger measures, and its consequent implementation with a documentation of its progress, can help cities everywhere to cope with their individual issues. However, the efforts

[2] This paragraph is co-authored by Felix Tettenborn.

New York City has undertaken depend to a large extent on the active engagement of the authorities, on the awareness of the population and last but not least on the technological progress, which still has not come to an end.

3.4 Buildings[3]

One of the strongest factors in NYC's recent development is the governmental support of building innovation, energy efficiency and sustainable city planning. A clear guideline for all decision makers and offices is manifested in PlaNYC. This helps provide transparency and facilitates faster processing and decision-making. The energy efficiency regulations have a strong influence on building development, both for new buildings under construction and old buildings required to undergo retro-commissioning. As part of the Greener Greater Buildings Plan (GGBP) local laws were implemented to insure energy audits of larger buildings. Such laws create new understanding and demonstrate that economic incentives for improvements and innovation pay off in the long term. It is important to remember that while sustainability is the goal, sustainable development is only achievable if it is proven financially viable. Therefore, investments into green building practices and retro-commissioning must be able to prove themselves economically beneficial in order to succeed and become widely adopted. Another way of creating better understanding of critical environmental issues is through education on sustainability. CUNY, a 'green university', provides an excellent case in point. The university is collaborating with the local government on a project that will, in time, help shape public opinion and make developers and residents aware of the need for sustainable buildings, thereby turning sustainability features into something people will value and want in a building. CUNY's green campuses set a positive example of green development and exemplify values of sustainability in a public space thus creating curiosity and admiration. The education and programs provided by the university produces future experts in sustainable technologies and trades. Additionally, program graduates have practical experience from contributing to their universities' green development initiatives. A green university is the ideal place to conduct research on developing new methods and concepts for sustainable buildings and cities. Another strong concept to create economic benefit from sustainable buildings is the public-private-partnership (PPP). By entrusting the project with valuable goals and clear guidelines to a private partner, to implement and treat it as a normal source of income, the government can reduce its financial investment. On the other hand, the private partner is provided with a profitable project that would not have been available to them without the incentives provided by the government. In this way, innovative projects can be realized much faster and with more security for both parties involved.

[3] This paragraph is co-authored by Elvira Ockel.

3.5 Mobility[4]

NYC ranks first in the nation in terms of passenger miles flown, transit passenger miles traveled and truck freight volume. In the year 2006, transit alone accounted for 1.8 billion passenger trips carrying 8 million passengers per day (almost 70 % in subways). New Yorkers are heavily dependent on public transportation and have a much lower car ownership rate (23 %) than any other major city in the country (78 % average). Moreover, NYC is the only city in the United States where more than half of the households do not own a car. Were the city to follow general car ownership patterns, the city would have an additional 4.5 million cars on its streets. The transport sector emitted 11.4 million tons of CO2 in 2010 (69 % from passenger cars) and is the second largest CO2 emitting sector after electricity generation. Due to low private car use, about 48 billion miles (approx. 77 billion km) of travel are avoided yearly, saving the city 23 million tons of transport-related CO2 emissions.

3.6 Governance[5]

In 2007 the master plan for New York City, the 'PlaNYC 2030' has been released and attracted attention as a global example of sustainable community and economic development. Three main challenges functioned as key drivers for the development of a comprehensive, strategic plan for NYC's development: the expansion of population, the city's aging infrastructure and the impacts of climate change on NYC. Moreover, the 9/11 events have raised awareness that a city must not only provide public services, but also create a safe space in which the future-oriented economic, social and environmental needs of a diverse and prosperous city can be met. Furthermore, projections for climate change impacts on the Big Apple highlighted the need for NYC to take action by preparing for inevitably negative impacts while striving to minimize its own impact on global warming. Thus, the concepts of sustainability and resilience became central guidelines for the future development of NYC. PlaNYC is an ambitious agenda aimed at creating a 'greener, greater New York' even as the city's population continues to grow towards a projected nine million residents by 2030. The ten fields of action which are part of the city's sustainability strategy include: Parks and Public Space, Energy, Brownfield, Air Quality, Waterways, Solid Waste, Climate Change, Water Supply. Additionally, PlaNYC presents seven topics, which are cross-sectoral: Public Health, Food, Natural Systems, Green Building, Waterfront, Economic Opportunity, and Public Engagement. The conception of PlaNYC and the implementation of its numerous initiatives is the result of a joint effort on part of the city, state and federal governments, citizens, neighborhood groups, non-profit organizations, community boards, private companies, as well as research institutions and universities. While McKinsey and Company assisted in writing the plan, the Mayor's Office of Long-Term Planning and Sustainability (OLTPS) released the plan. Support from the mayor and

[4] This paragraph is co-authored by Martha Loleit.
[5] This paragraph is co-authored by Katrin Eisenbeiss.

top administration officials has been fundamental for the successful and efficient implementation of PlaNYC.

4 Analysis of Projects and Processes

The description of structures within a city must always be understood as a still-life, capturing a specific moment in time. The transformation of a city towards a sustainable state requires the transformation of these structures, which is why the analysis of projects and processes - taking into account their time-related dimensions - are of central importance in this research project. The key question is: What is required in order to shape these transformational processes successfully in each individual project? In order to identify the causes underlying the successful implementation of projects, it is helpful to divide the processes into project phases, as shown in Fig. 4. Each project phase depicts a different structure of actors involved. A project tends to be successful only when the implementation of all phases is successful. If, for example, a project's goals are not clearly enough defined, or, if at the end of the project the resources available are not sufficient or the responsibilities have not been laid out clearly enough, optimal project implementation will not be achievable. The approach of dividing the process into project phases can be applied to individual projects, long-term accompanying processes (such as, for example, the Sustainability Council) as well as the entire transformational process towards a more and more sustainable future as a whole.

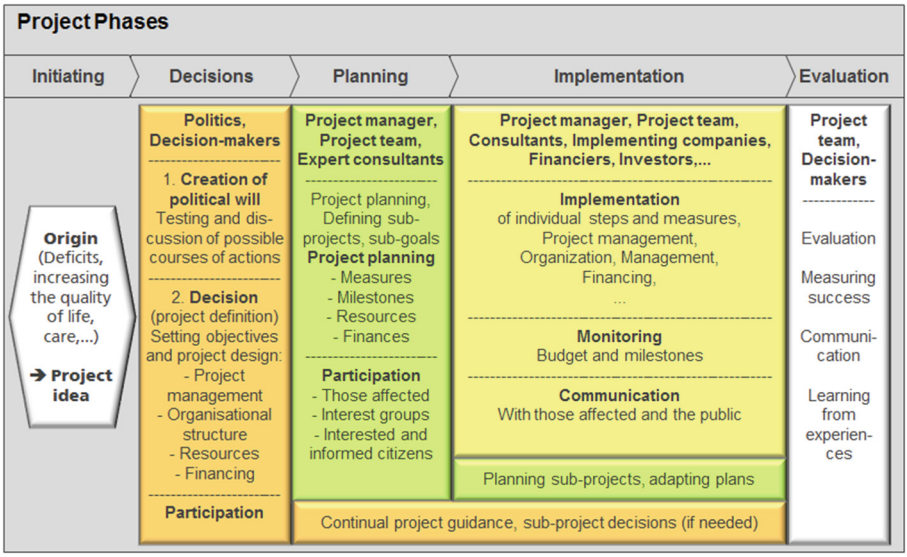

Fig. 4. Typical project phases in a transformation process (Fraunhofer IAO et al., 2013b, p. 105)

4.1 Key Success Factors

Successful implementation of a project depends on solid planning. However, external drivers exert pressure on projects, which influences successful implementation. Some of these factors and their effects are known at the beginning of the project. These will exert influence throughout the duration of the project and are already taken into consideration during the planning phase. Other factors only become significant during the course of the project, and may require adaptation of the project. Both types of factors - and the boundary between the two is fluid - can prove to be either beneficial or damaging to the project. This research has the goal of identifying the most important drivers within a city, in order to understand the reasons behind the courses the projects take and to gain insight into the transferability of the practice examples analyzed. This is valuable information, since it can be assumed that transferability is a given, provided the most important factors (in this case success factors) within the city studied are also present in the city the project is being transferred to. In NYC's practice examples, 36 factors were identified with varying effects on the successful implementation of the practice examples. The factors were assigned to one of twelve categories, which led to an average of 3.61 factors per category.

4.2 Reciprocity of Factors

Figure 5 visualizes the reciprocity of the factors. The placement of the factors was selected using the Kamadakawai-algorithm, which chooses the position based on the centrality index of the corresponding node. We can see that even though Mayor Bloomberg has a higher number of nominations, the three factors, 'public available data', 'open mind' and 'evidence-based policing', have a more central

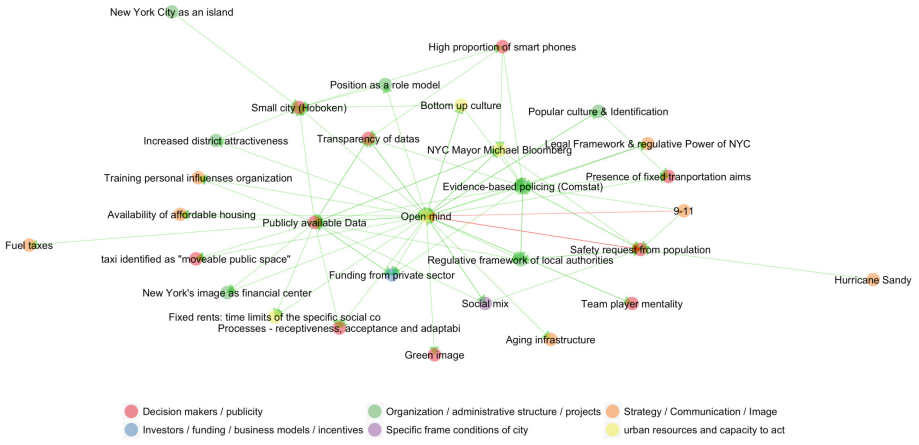

Fig. 5. Representation of the reciprocity of the factors. Positive interactions are coded in green, negative interactions in red. (Color figure online)

position in the NYC urban system, at least in the investigated projects. Of these factors 'open mind' is in a prominent position. This becomes obvious when we take a look at the out degrees (Fraunhofer-Institute for Industrial Engineering IAO 2013). The open-minded population of NYC is a central factor in the success of the city's project implementation and is one of the main cultural foundations of this city. Residents' open-mindedness has allowed the city to forge new paths without meeting resistance. A good example of this is the availability of venture capital for start-ups. Where in Germany a start-up needs to prove a concept by referring to the successful implementation of other projects and processes, start-ups in the United States and especially in NYC have easier access to venture capital because, even if there is no proof of concept, the start-up can acquire capital if it can convince the stakeholders that their idea is innovative. This fundamental cultural characteristic opens the door to trying out new concepts that are unthinkable in German cities. However, this advantage comes with a price. On the one hand, actors in NYC can test innovations which elsewhere would be smothered in the early discussion stage. On the other hand, they run the risk that the project develops in a way that could negatively impact the population. An example is the data-driven society. The open data initiative has huge advantages in the blending of different entities or in a better understanding of social systems. The drawback, however, is that such systems can easily jeopardize citizens' security and privacy.

4.3 Impact Factors

The most influential impact categories are the urban resources and political actors. The most influential political actor is, as already mentioned above, Mayor Bloomberg, who stepped down as Mayor in 2013 after 12 years in office. It is not possible to estimate what future impact his successor, Bill de Blasio, will have on NYC. Aside from the mayor there are also other political actors who are important for the described projects. For instance, in the case of the Open Data Initiative, Gale Arnot Brewer is of particular importance.

5 Learning from New York City

One of the central elements in NYC is the usage of data and IT. However, the usage of data and IT is not an end in itself. The process started with the citizens' request for an overview of the city's data in order to make the government accountable and to increase transparency. The citizens wanted to know what their tax money was being used for. United States residents, particularly New Yorkers, realized that economic market principles could also be used in governmental and political processes. Therefore, under the leadership of Mayor Bloomberg, the NYC administration implemented an assessment system that sets verifiable goals and measures their status with defined indicators, which were enshrined in PlaNYC, before applying policies as well as during the implementation process. Only if a policy is successful will the government continue the

program without making adaptations. If a policy is not successful, the initiatives are either adjusted or stopped.

In NYC this evidence-based governance is highly IT and data driven. For this reason, Mayor Bloomberg created the 'Office of Policy and Strategic Planning', a group of civic-minded number crunchers, lead by Michael Flowers, who work directly with the mayors office. Flowers, while not connected to New York's political system, was an external person with a good idea - using predictive informational techniques - that he presented to John Feinblatt, the Mayors chief policy adviser. Flowers, however, is not the only external person who has been brought on board by the city's administration. The Bloomberg administration was known for seeking out expert knowledge when necessary to become more objective and evidence-based. As a result, the solution for a lot of things are not only based on ideology but more and more on the question of 'does it work? Does it have a measurable benefit?'.

Applying this approach to the studied practice examples gives a diverse answer to questions about the projects' benefits and adaptability. If we look at a project that has a comparatively low density, such as 'Via Verde', we need to conclude, according to Edward Glaser (Glaeser 2012), that from the perspective of sustainability this is not beneficial, however, it is from a community perspective. Based on this information, we now can decide which we consider more important. In other words, a decision must still be made, however, the decision is now based on a more objective analysis. To provide another example, we can also conclude that the 'Electric Vehicle Pilot' project works in NYC because of the city's population density. We know that such a project can be adapted by cities with a similar density but should question whether it would also be successful in a low-density area. The IT and data approach, and the resulting increase in transparency, is not only useful for holding the government accountable but also for monitoring and assessing individual decisions and gives consumers a basis for their decisions so that they can make informed choices. The Solar Map initiative, for example, enables citizens to calculate the return on investment of the installation of a solar panel in any given location. Likewise, the LEED certificate provides information on building construction and retro-commissioning and provides estimates in regard to estimated costs. Overall, data and ICT plays a central role in NYC. We can say that NYC is the most ICT-based city of all cities studied in this project. It is important to note that the IT systems used enable the information usage and increase the accessibility to such information (i.e., publish data, analyze data, etc.). They are not sustainable by themselves, but can be used as a tool for sustainability. ICT is also used to automate a lot of processes like water treatment, quality measurement and security surveillance. The positive effects of this approach come at a cost. To get a benefit out of the data, one needs to be able to analyze it and understand the implications of the results found. This requires a high level of education, and computer science and statistics are becoming increasingly fundamental abilities, similar to reading and writing. Those who are unable to understand these cultural techniques are more likely to be over-proportionally disadvantaged. Knowing this,

NYC tries to enhance the public school system and improve its universities as well as found new ones. Such initiatives are economically beneficial as they attract knowledge-based companies. Likewise, existing universities adjust their programs accordingly and offer more data-driven degrees and degree programs while also focusing more on sustainability aspects, like CUNY is doing. Overall, we can summarize the process as the transformation from an economic system to a knowledge-based system. We can see that Berlin is on a very similar path. It is approximately at the position that NYC was in about ten years ago. If Berlin continues down this path, similar approaches and results may be seen in Berlin in the future as were observed in NYC. In addition to being related to ICT, the success of NYC is also rooted in its cultural setting. The United States in general, and NYC in particular, has a very strong grass roots movement, which originates in strong community (not necessary neighborhood) relationships. This leads to a 'team player' mentality that is dominant in almost all studied projects. The citizens are also very open-minded and willing to try out new approaches and methods. The benefits of evidence-based policy (e.g., a tremendous reduction of crime within the city limits) strengthen this effect additionally because the policies can be seen to have a direct benefit. In addition to its cultural characteristics, it is interesting to see that New York City - under Bloomberg - had a very central style of planning. This was physically expressed in the arrangement of the mayor's office: his desk was in the middle of an open office surrounded by his employees. He was responsible for the data driven approach, the PlaNYC, OLTPS and other similar initiatives. Central support increases a project's weight and reputation. However, the city government, for the most part, functions as a framework that sets project boundaries while the actual implementation is often realized in a Public-Private-Partnership. The sustainability efforts must also be understood under this maxim. The government sets the goal for the city to become more sustainable, but the approaches need to have a positive measurable outcome for the city. Based on the culturally-founded subsidiarity principle, Mayor Bloomberg, like the intellectual urbanists Benjamin Barber (Barber 2013) or Edward Glaeser (Glaeser 2012), sees the city as being responsible the problems and able to provide the solutions for the challenges in sustainability.

6 Prospect

The recently started second phase of the Morgenstadt project will be a transformation of the project into an ongoing alliance of industry, cities, and research partners that will join forces for the purpose of accelerating innovation throughout the various research sectors and for creating showcases for transformative urban projects. The focus in this phase of the project will be the development of detailed, innovative cross-sectoral urban sustainability projects and their implementation within context-specific complex city systems. The primary mission of the City Insights Network will be to identify, conceive, initiate and implement pilot and demonstration projects for sustainable urban solutions in cities around the world. Projects will be developed in variable consortia made up of industry,

city, and research partners. The City Insights Network is designed to address the challenges that were mentioned above with a new collaborative approach. The aim of the second phase of the Morgenstadt project is therefore to initiate and accelerate the long-term transitions of selected cities towards sustainable urban systems and to thereby create international reference projects on the level of entire cities. Morgenstadt aims to become the first global alliance for planning and implementing large-scale sustainable urban solutions in a range of cities around the world.

References

Werkzeuge des Wandels: Die 30 wirksamsten Tools des Change Managements. Stuttgart (2012)

Benjamin, R.B.: If Mayors Ruled the World Dysfunctional Nations, Rising Cities. Yale University Press, New Haven (2013)

Flegenheimer, M.: After Decades, A Water Tunnel Can Now Serve All of Manhattan. The New York Times, New York City (2013)

Fraunhofer IAO, Fraunhofer IFF, Fraunhofer IBP, Fraunhofer IGB, Fraunhofer ISE, Fraunhofer IML, Fraunhofer EMI, Fraunhofer IPA, Fraunhofer FOKUS, and Fraunhofer ISI: Innovation Network "Morgenstadt: City Insights". Technical report, Fraunhofer-Gesellschaft, Stuttgart (2013a)

Fraunhofer IAO, Fraunhofer ISE, and Fraunhofer IBP: Morgenstadt City Report. Technical report, Fraunhofer Gesellschaft, Stuttgart (2013b)

Fraunhofer-Institute for Industrial Engineering IAO. Morgenstadt: City Insights. Technical report, Stuttgart (2013)

Glaeser, E.: Triumph of the City: How Our Greatest Invention Makes Us Richer, Smarter, Greener, Healthier, and Happier, 2nd edn. Penguin Books, London (2012)

Kalisch, D.P.H., Wetzel, T.: Morgenstadt DB. Technical report (2013)

Kalisch, D.P.H., Schatzinger, S., Braun, S., von Radecki, A.: Morgenstadt: City Insights. A research approach for systems research in urban development. In: Proceedings RealCORP 2013 (2013a)

Kalisch, D.P.H., Tettenborn, F., Eisenbeiss, K., Loleit, M., Leisz, H., Ockel, E., von Radecki, A.: Morgenstadt City Report. Technical report, Fraunhofer Gesellschaft, Stuttgart (2013b)

Mille Bojer, M., Roehl, H., Knuth, M.: Mapping Dialogue Essential Tools for Social Change. The Taos Institute Publications, Chagrin Falls (2008)

United Nations: World Urbanization Prospects. The 2011 Revision. Technical report, New York (2012)

Wendt, W., Kalisch, D.P.H., Vandieken, T., Engelbach, W.: Smart cities and ICT-insights from the morgenstadt project. In: Proceedings of RealCORP 2014, pp. 533–541, May 2014