

# The Morgenstadt Model a City of the Future Framework



# **Profile of the Fraunhofer-Gesellschaft**



- Founded: 1949
- about 24,000 staff
- **69** institutes and research units
- Fraunhofer worldwide

**Europe:** Brussels (Belgium), Budapest (Hungary), Porto (Portugal), Gothenburg (Sweden), Bolzano (Italy), et al.

**USA**: Boston, Brookline, Cambridge, East Lansing, Maryland, Newark, Plymouth, San José, Storrs

North/South America: London (Canada), Santiago (Chile), Salvador and Sao Paulo (Brazil)

Asia: Ampang (Malaysia), Beijing (China), Jakarta (Indonesia), Koramangala Bangalore (India), Seoul (South Korea), Singapore, Tokyo and Sendai (Japan)

Africa/Middle East: Dubai (United Arab Emirates), Cairo (Egypt), Stellenbosch and Pretoria (South Africa)



# **Profile of the Fraunhofer-Gesellschaft**



- Annual research budget: 2.1 billion euros\*
- Including over 1.9 billion euros for contract research\*
- Over **70%** of this sum is **generated** through
  - projects commissioned by industry and
  - publicly funded research projects
- Roughly 30% is provided by the German state and federal governments for advanced research (looking at issues that will be of concern to the economy and society in general in five or ten years time).

\* Figures for 2016



### Fraunhofer Innovation Network "City of the Future"

- One of the key projects in the Action Plan of the Federal Government's High-Tech Strategy 2020
- 12 Fraunhofer-Institutes started the »Morgenstadt-Initiative« in 2011 for supporting the national initiative
- The innovation network »Morgenstadt: City Insights« is a longterm alliance to increase investments in clean urban innovations across cities, companies and research.





### A systemic approach to urban markets

- Morgenstadt is an Innovation Network that strives to design the future market for sustainable cities.
- It comprises of the main stakeholders that plan, finance, build, manage and operate cities, and it is run by the German Fraunhofer-Society.
- The main purpose of m:ci is to solve urban challenges by translating them into potential innovations and piloting solutions in new consortia.





# **Innovation Network Morgenstadt**







•				Project Director	Network Coo	rdinator	1.0	
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,					DI. N. 1140-			
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IWES	IBP	IAO	IAO	IML	IGB	IAO	IFF	IAO
R				S	<b>S</b>			<b>Solution</b>
C. Sager	H. Erhorn	N. Fanderl	P. Suska	D. Fahrenholz	Dr. M. Mohr	W. Wendt	C. Hoepfner	M. Padilla
ISE	IWES	IAO	IAO	IPA	ISI	FOKUS	EMI	IAO
G. Stryi-Hipp	S. Bofinger	T. Ernst	D. Wagner	Dr. G. Hörcher	Dr. H. Hiessl	Dr. I. Schieferdecker	D. Hiller	T. Hawxwell



7

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# Key approaches to boost innovation in cities



**SMART CITY** 

RESEARCH

### CITY LABS

# Fraunhofer MORGENSIADY CITY LASS Eperts & Planes Cites & Municipalities Indutry NO's & Verbande

**INNOVATION** 

PARTNERSHIPS

### **City of the Future solutions database** Technologies and Solutions for clean & sustainable cities



### Example: Value of Data – Fraunhofer IAO research

Nightime Economy in London

Cyclist Safety in Dublin Labour Market in Berlin Water managment in Copenhagen

Enabling cities to **exploit** the maximum **potential** that urban data holds, while giving the companies working with data to gain a unique **insight** into particular complex urban **challenges** 

**Delivering** value of data <u>use-case catalogue</u> **Developing** a data value model **Advancing** local data marketplaces and evaluate best models for pricing and transactions of urban data



# **Example: Innovation Partnership Eindhoven**



Partnership between 2 cities, companies, 1 university and Fraunhofer IAO to develop 2 smart districts, one "Smart Society Academy" and several innovation-driven projects.







### **Smart City Solutions Database**



### MORGENSTADT SOLUTIONS PORTFOLIO

Design and implementation of key modules for the sustainable city of the future

**Fraunhofer** 

🖉 Fraunhofer



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11



Architects of the Urban Market

Architects of the Urban Market



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### **Smart City Solutions Database**

BABLE

SPOT CREATE EXPLORE STORE MY BABLE



### Vehicle Sharing System

Vehicle sharing systems allows customers to use various vehicles without owning them. There are different types of vehicle sharing systems on the market. Differences can be the vehicle shared, as car sharing, bike sharing, socoter sharing or electric vehicle sharing. Besides the type of the vehicle one main difference between vehicle sharing systems is the vehicle holder. Most commonly, the operator owns the vehicles he shares with his customers. Another opportunity is peer-to-peer vehicle sharing, where the users share their own vehicles. For each vehicle sharing system, it is necessary to ensure the accessibility of the vehicles and to manage the location and operation of the vehicles. These mandatory and additional functions of the vehicle sharing system are shown on the left. The impact of the system varies depending on the functions implemented. Regarding the benefits of the solution, this is evident. The benefits, which can be achieved by a system containing all additional functions below, are shown as potential benefits whereas the general benefits can be reached by implementing the mandatory functions only.

KEY FACTS

Initial Investment Amount: 1,000,000 Euro to 5,000,000 Euro for a

### MOVE PASSENGER

Products which move passengers towards their destinations, as electric buses or cars

### \_

INFORM CUSTOMER

Products which help to inform customers, for Functions 1) mandatory functions: access service move passenger pay for service manage vehicles inform customer 2) additional functions:

Implementation Facts

Average Implementation Time: < 2 years

charge vehicle

system with 150 cars

### BENEFITS

Reducing traffic congestion Improving parking Improving life quality Promoting sustainable behaviour Reducing local air pollution

### Potential Benefits

Reducing GHG emissions Supporting environmental efficient transport Promoting electric vehicles Limiting urban sprawl

ACCESS



MANAGE

VEHICLE

Products which manage

the operation of the vehicles, this can include

for example maintenance

planning

### Market Overview

Most of the vehicle sharing systems, which are already implemented depend on agreements between a car-sharing company and city administration, especially regarding parking policies. Existing use cases have proven to be highly successful in cities. According to Navigant Consulting, the industry worldwide currently has an estimated size of \$1.1 billion and is expected to grow to \$52.5 billion by 2024.

**BUSINESS MODEL** 

(Korey Clark, 2016)



The most common business model vehicle sharing systems around Europe is the order of free-fooling rentals. The cars can be parked park in specially designated parking spaces or in standard parking areas with a permit from local municipality. The customers are charged in a permite base and in terms of a subscription fee. The minute-based fee usually varies between 0.2 eliminute and 0.5 eliminute, depending on the vehicle sharing system and the vehicle sharing companies also offer hour-based or daily-based or tables.

Besides the revenue of the charges, the cars can offer a marketing channel for the vehicles within the fleet. The main costs of a vehicle sharing system are the initial costs for vehicles and the chargers if necessary. The operational costs are mostly the costs for fuelling, maintaining and cleaning the vehicles as well as costs related to customer service and insurance.

(Dr. Scott Le Vine et al., 2014), (Francesco Ferro et al., 2015)

### **Business Model Canvas**

The picture shows a typical carvas for a vehicle sharing system. It gives an overview on the business model discussed above. Some of the aspects are not needed or implemented when integrating the basic version of the solution vehicle sharing system, but they come along with implementing some of the additional could-have functions.

S The Rusiness Model Canvas

http://www.bable-smartcities.eu/explore/solutions/mobility/598a605aad51200004cf1783









MORGENSTADT CITY LABS

# Morgenstadt City Labs a City of the Future Framework



# **Background: understanding the complexity of sustainable** urban development



Understanding the Freiburg principle

Understanding the Singapore Principle



Understanding the Berlin principle

Understanding the Tokyo principle

Understanding the NYC principle



Understanding the Copenhagen principle





### **Research approach: from sectors to action fields**

- Assessment & evaluation of key drivers of sustainable urban best practices
- Recombination of key drivers & development of fields of application
- Systems innovation & development of new solutions





# **Selected Best Practices**

Copenhagen Carbon Neutral by 2025







Greener Greater Buildings Plan (NYC)

Demonstration Scenario for Public Safety and Security (Berlin)

Innovative urban development concepts (Berlin)



Electronic Ticketing Tokyo (PASMO / SUICA)



### **BIOSKIN** facade



Mobile Spatial Statistics

Copenhagen District Heating







### Morgenstadt Framework



1. What is the quantifiable sustainability performance of the city today?

2. How does the city address a smart and sustainable development today?

3. Why and how do or don't things work in this city?



Standardized Data Assessment helps to identify key challenges & opportunities

### Morgenstadt Framework

Analysis of Interfaces helps to design individual strategies for cities

What is the sustainability performance of the city? Assessment of Indicators

How does the city address sustainability? Assessment of Action Fields

Why and how do or don't things work? Assessment of Impact Factors





# **DPSIR-Framework for Sustainable City Development**

To measure the quantifiable sustainability performance of a city

ON CITY PATA

# Which external and internal pressures are acting upon the entire city system?

### 33 Pressure Indicators

- Environmental Pressures
- Pressures from the energy
  system
- Socio-economic press
- Political Pressures
- Pressures on Resilience
- Pressures from Transpo Production
- Pressures on the water system
- Pressures from the built environment

What is the current state of the relevant subsystems of the city?



- State of Socio-economic system
- State of ICT system

What is the current impact of the city-processes on the social, economic and ecologic dimensions?

### **14 Impact Indicators**

- Environmental impact of local combustion processes
- Mobility impact on society
- Impact from built environment
- Impacts from economic system



# Key action fields for sustainable urban development

To understand how a city addresses a smart / sustainable development



	Strategy and Planning			
Urban	Local policies (Regulations & Incentives)			
Leadership	Finance & Procurement			
	Organization & structure			
	Data governance and IoT			
<b>F</b>	Local innovation ecosystems (R&D & Business)			
Enabling	Urban Planning			
suategies	Socio-Economic Development Model			
	Citizen engagement & participation			
	Energy systems (provision and demand)			
	Waste & Resource Cycles			
	Water solutions			
Technologies &	Mobility and Transport solutions			
infrastructures	Urban production & logistics			
	Sustainable buildings & refurbishment			
	Green Infrastructure & Ecosystem Services			
	Resilience Engineering			



# Sustainability strategy profiles





# Sensitivity analysis of local factors

To understand how projects need to be designed in this city in order to be successful

Methodology for identifying and rating individual impact Factors (local key drivers, framework conditions, barriers, success factors, stakleholders)





# **City Lab assessment model**



	City System Level	Action-fields Level		
Quantitative Data	Quantifiable indicators in geography, population, economy, social aspects, environment, politics. Quantifiable indicators for the eight defined sectors Level of consideration: The city Sources: Statistical data about the city	Key performance indicators related to the observed fields of action. Defined questions/indicators for the cumulative assessment of the action-fields. Level of consideration: action-field Sources: documents and publications about the action-field	35%	Level 1: Analysis of th urban system
Qualitative Data	Interview guidelines and leading questions about city goals, strategies and measures, and about structures, factors and actors in politics, administration, the economy and civil society. Interviewees: heads of departments, chief officers, CEO's, politicians and civil society representatives. Additional sources: Master plans and strategic documents.	Interview guidelines and leading questions about actors, business models, technologies, financing, goals, strategies and measures within the individual fields of action. Interviewees: Project leaders, CEO's, financiers, heads of departments, involved researchers, project members, users Additional sources: documents and publications about the project.	65%	Level 2: Analysis of action fields (specific)



### (Structured group discussion)

City Lab cycle

10 – 12 **Months** 







### **Morgenstadt City Labs**







### **City Lab Prague - Indicator Assessment**

### Prague





Action Fields Impact Factors Add Impact Factor

Indicators Add Action Field Values Add Indicator Values

### Indicators



S50\_GDP of city

Value	30 337 EUR	CSU	31.10.2012		published		per capita
\$5_W	ater quality						
Value	99,5	http://www.pvk.cz/res/ar	31.12.2014		31.12.2014		Add Comment
S55_4	Average age of city popu	lation					
Value	42,0	Czech Statistical Office	31.12.2013	ш	04.05.2015	ш	Add Comment
S13_N	Nr. of full-time firefighter	5					
Value	0,74	Fire Rescue Service of 1	31.12.2014	ш	04.05.2015	ш	%
\$12_N	Nr. of police officers						
Value	6,70	Police of the Czech Rep	31.12.2014	=	04.05.2015		%0
\$57_C	Doctors per 100,000 resid	lents					
Value	128,7	Institute of Health Inform	31.12.2013		04.05.2015		Add Comment
\$14_I	Medical emergency respo	onse personnel					
Value	0,24	ZZS HMP	31.12.2014	ш	04.05.2015	ш	%0
S56_L	ife expectancy						
Value	Male 77,3, Female 82,1	Czech Statistical Office	31.12.2013	ш	04.05.2015	ш	2012-2013
\$11_F	Reaction time of first res	oonders					
Value	7,5	ZZS HMP	31.12.2014	ш	04.05.2015	ш	minute
S54_H	lome ownership rate						
Value	39,7	Czech Statistical Office,	26.03.2011	=	04.05.2015		Add Comment
S59_I	nternet connectivity						
Value	69,3	Czech Statistical Office,	27.03.2011		04.05.2015		Add Comment

\$39 Water supplied from stormwater harvesting/ reuse of treated water



### **Indicator Analysis - pressures**



Environment Socio-economic Mobility Energy Water Public transport consumption average Above Unemployment Debt service Population **Average** Rent level Energy demand avergae Below Freight traffic Bicycling



### **Indicator Analysis - state of systems**







### **Assessment of Action fields**





74 Targe	ted co	ombination of	different mod	es	of transport ×			
T5c : Are transp planning tools?	oort operat (y/n)	tors coordinating individua	I modes of transport (tim	ing a	and arrival times) through			
🖲 Yes 🔍 No	Source	TSK, http://www.prahou-	07.05.2015		But regulation is focuse			
T5a : Does your city provide one ticket for all mobility alternatives (public transport, car-sharing, etc.)? (y/n)								
🔍 Yes 💿 No	Source	IPR	07.05.2015		Comment			
T5d : Has the city increased the nodes of transport that allow to switch between different means of transport in the last 5 years? (y/n)								
🖲 Yes 🔍 No	Source	IPR	07.05.2015		Comment			
T5b : Can users in your city use an online application (App, Website etc.) to plan multimodal routes? (y/n)								
🔍 Yes 💿 No	Source	IPR	07.05.2015		But in case different mo			
				(	Close Save changes			



### -Governance

- Strategic development topics not on political agenda
- New partnership with private sector necessary
- Strong need for "Smart Governance"
- Need for integrated management approach
- Lack of clear vision for future-proof urban development
- Lack of coherent development strategy with measurable goals

### Energy System

- High demand for energy and electricity
- Potential for renewable energy use is not well exploited
- Various barriers for the use of renewable energy sources
- Incentives for energy efficient industries are needed

### Buildings

- Lack of crucial information on energy performance of Prague's building stock
- Collection of data on energy performance requires political will as it is associated with high upfront and operational costs
- Modernization rate of the building stock is low
- Strong need for a new Building Code containing clear regulations



### – Space, Planning & Mobility

- Urban sprawl has resulted in road congestion and air pollution
- A reduction in car traffic has not been achieved despite significant investments
- Prague has no soft mobility systems (P&R, B&R, car-sharin mobility hubs)
- Use of private cars is still perceived as more attractive than public transportation
- Little colllaboration between City of Prague's and Prague Region's transportation systems

### — Economy & Innovation

- Promising innovation landscape
- Enterpreneurship hindered by risk-adverse conservative mentality
- Spatial distance to main technological hubs
- Lack of cooperation in R&D
- Businesses relocate away from Prague in search of tax reduction benefits and lower living costs
- Established tradition of excellent technical and mathemat cal education
- Potential to become an international a hub for IT, creativit and culture



### **City Lab Prague - Impact Factors**







### From analysis to action (selected measures)



Leadership Level	<ul> <li>Definition of (long term) Goals &amp; Vision for Prague</li> <li>Creation of strategic management unit</li> <li>Organization of learning journeys to Europe's Smart Cities</li> </ul>					
Strategy Level	<ul> <li>Development of Smart City Think Tank</li> <li>Set up Smart City Innovation Fund</li> <li>Install Integrated management system for the city administration.</li> <li>Use Gamification &amp; nudges for activating the local population</li> </ul>					
Technology & Infrastructure Level	<ul> <li>Development of an Innovation District</li> <li>Development of a Transportation Hubs Network</li> <li>Smartification of historic city centre</li> <li>Lighthouse refurbishment of public office buildings</li> </ul>					



# **City Lab Leipzig: Three levels of action**







# **Tbilisi City Lab: Three levels of action**







# **Prague City Lab: Three levels of action**







# Lisbon City Lab: Three levels of action







# Linking activities to action fields







### **Measuring impact: monitoring & evaluation**







# The local mirror team – crucial for success!





- Capacity building
- Inducing ownership
- Assuring long-lasting impact

"Never before have I learned so much about my own city" Oriol Llevot - Sabadell



### **City Labs – Costs & Benefits**



### Costs

- Ca. 20 30 PM per City Lab
- Ca. 300 450k EUR
- Local mirror team necessary
- Several meetings "on-site"

### Benefits

- Ca. 25 bankable projects per City Lab
- > 10 Mio EUR investment
- Project ownership secured
- Private / municipal coinvestments
- Governance strategy in place





# **City Lab Strategies**



### (Local) Innovation

or

- Strong focus on local innovation ecosystem
- Co-creation approach with local SME's and companies
- Strong involvement of local universities
- Focus on piloting of innovative solutions

### Infrastructure Investment

- Strong focus on lower risk investments
- Strong collaboration with international industry partners
- Focus on standardized & replicable solutions and business cases





Research and solutions for a sustainable world.



# Thank you!

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