Fr	B	C	NY	S	T	Total
0	0	8	10	10	10	38

Example:
New York: as the frontrunner within the field of the six analyzed cities within m:ci, in June 2013 New York has introduced a comprehensive plan 'A Stronger and More Resilient New York' which could become a best practice example for other metropolitan areas worldwide in moving towards an adaption of a resilience-by-design approach not only referring to a limited number of Critical Infrastructure, but instead encompassing all sectors of private and public urban life. Its recommendations span across the entire resilience cycle of preventative measures (both physical and cyber) over protection solutions for home owners and CI operators to be better prepared against disasters of all kind all the way to response and recovery measures for all stakeholders to be adapted and implemented in order to make existing and especially new systems and infrastructures resilient-by-design against multiple hazards.

Copenhagen: over the past decades, Copenhagen has had numerous exceptional opportunities for large urban development projects, the Ørestad quarter and the inner harbor area just two name a few. With the redevelopment and eventually the extension of the Nordhavnen district into an entire new city district, the city is now in the midst of launching the next generation large-scale development project that will set new standards in many ways: Not only will it provide living, business and office space to a few thousand Copenhageners, it will also be an experimental area where innovative concepts and technologies in various sectors (water, energy, mobility, security) can be tested and piloted. Resilience as a design principle when defining the resistance criteria of the various sub-systems of this quarter against numerous hazards is being implemented by the city in an unprecedented way.

1. Differentiated description of the key field

Within the expert communities of urban security and resilience, a call for 'resilience-by-design' concepts has been underscored as an imperative for researchers, engineers and end-user communities for numerous years. However, so far in many countries this idea and concept has not progressed beyond academic concepts and ivory tower disputes into hands-on implementation in technical and socio-technical urban systems. But all observations within the analyzed cities indicate that aside from some exceptions, a clear step towards implementation of this 'by-design-approach' has already started and is more than likely to increase tremendously over the course of the forthcoming decade. The reasons are evident: a strong increase of population density in urban areas on one side (rising vulnerabilities) whilst an increasing number of extreme weather events, crime and terrorism related issues as well as increasingly fragile urban supply-chains (just-in-time production and delivery, systemic vulnerabilities of highly strained CI, cascading effects in case of emergencies) require urban systems capable of withstanding major shocks and disruptions as well as the capacity to quickly recover from then in order to provide the urban population with vital functions of its every day life.The following pillars ought to be understood as core pillars of such a 'resilience-by-design' approach where cities are likely going to become more active in the future. Accordingly, such pillars include:
- an identification and in-depth analysis of the existing and the expected risks and stress-fractures the respective infrastructure or social unit/system is/may be exposed to (See also SF 109)
- A systematic, hence regulated and formalized (norms, regulations) procedure of integrating all critical security aspects into the (re-)design and planning process of existing and new infrastructures (from complex mobility systems all the way to individual buildings).
- Solutions to better model and simulate complex systems at operational as well as emergency level including the capacity to identify systemic vulnerabilities of systems on a micro as well as macro level
- The development of new multifunctional materials (energy-efficient, adaptive, energy-absorptive as well as high-strength) and construction methods allowing to successfully address the challenges posed by overall sustainability goals
- The planning and design of comprehensive training and exercise procedures including all relevant stakeholders (citizens, businesses, public authorities, NGO's, etc.)

2. Reference to sustainability:

The message here is quite simple: whether existing urban infrastructure is considered in established urban areas (such as all the ones analyzed within the project m:ci) or brand new cities and city districts are the object of interest in emerging countries and economies with tremendous growth developments, the overall resilience-equation is absolutely congruent with the general definition of sustainability (see Bruntland-Report): If the urban systems of the future do not incorporate a 'resilient-by-design' approach they will not be able to absorb the shocks and disturbances caused by an increasingly demanding and partly rough (climatic, geological, political and social) environment. Hence, continuously rebuilding, reinvesting and reconstructing infrastructures and systems that are highly susceptible is neither efficient nor preserving resources in any way. That is why in its overall definition of sustainability, the UN have moved to

fully incorporating 'disaster resilience' as one of the 7 pillars of defining sustainability.

3. Relevance to industrial sectors?

Mobility:	High
Energy:	High
Production & logistics:	High
Security:	High
ICT:	High
Water infrastructure:	High
Buildings:	High
Governance:	Middle

Brief description of the high level of importance:
With only minor differences, all sectors listed fulfill vital functions for overall well-being of an urban population. Thus, their characteristic of being 'resilient-by-design' becomes increasingly critical

4. Impact (positive & negative)

Positive:
- Risk awareness among all stakeholders is rising
- Saving economic and material resources in the long-term
- Enabling CI operators to optimize emergency planning and operations
- Reducing vulnerabilities of citizens and infrastructures

Negative:
- Cost-intensive
- Long-term need vs. short term financial benefit

5. Implementation measures:

First and foremost, planners, architects and engineers are in need of new design tools that allow for such a systematic integration of resilient-by-design approaches. New Software-based tools are only one solution that is currently on the move in various countries.
Second, a change of not only procedures abut even attitudes along the entire value chain of CI protection and security must be enhanced via innovative concepts that still need to be developed.
Otherwise, as the case of Business Continuity Management (BCM) in various countries indicates that the existing business case models rather speak against an implementation of resilience measures against so-called low-probability high-risk events within especially businesses. Hence, only changes in regulatory guidelines and laws that companies and operators would have to abide to would lead to more resilience efforts.
Research specifically addressing this aspect is still at an early stage and must be continued on various levels: across the relevant disciplines (engineering, social science and economics) experts must find feasible tools and indicators to substantially advance this field in the near future.

6. Actors: Who can shape things?

- City planners
- Architects
- Engineers
- Research communities
- Technology providers

7. Prerequisites:

- Awareness of the stakeholders to incorporate the concpet
- Long-term planning
- Willingness to create incentives

8. Obstacles/barriers:

- Economic cost
- Complexity of system's and their risks
- Inteconnectivity of sub-systems
- Data protection, privacy (public institutions)

9. Indicators:

- Building regulations
- Resilience scorecards for infrastructures
- Performance indicators for security systems
- Emergency planning
- Risk mapping

10. Special features/remarks: