



Horizon 2020 Call: H2020-INSO-2014

Proposal number: SEP-210134170

Assessment of NOVEL Approaches to Alignment

Case Study No.6 – New York University Center for Urban Science and Progress

Date: June 2017

Dissemination level: Wider public

Lead contractor for this deliverable: AIT

Contributors: MIUR, UNIMAT, INRA



ABSTRACT

This case study examines the key features, outputs and overall strengths and limitations of the **New York University Center for Urban Science and Progress** with respect to the coordination of policy challenges posed by modern cities and the research and education activities of a graduate school. In 2012, a New York University led consortium consisting of academic, industry, and city government partners won the bid to establish a **unique public-private research center specializing in urban informatics**. CUSP utilizes its big data capabilities to integrate, analyze, and model a variety of data from across city agencies, and develops innovative data tools and infrastructure in order to devise practical, impactful findings and solutions to real-world urban challenges. This case study demonstrates the effectiveness of a research infrastructure built by joint efforts of academia, city authorities and industry. Although CUSP showcases cooperation on city/state level only, it nevertheless is a good example of how a transdisciplinary research infrastructure could be developed. If this model is transferred to Europe, it would benefit from a transnational approach for most impact. Therefore, it serves as an interesting lesson for European P2Ps planning to set up a joint research and data infrastructure to address common challenges.

This case highlights the following **strengths** of such a coordinated approach:

- **Enhanced inter-institutional cooperation between academic institutions & academia and city government:** CUSP works closely with its academic partners and staff, building towards coordination of thematic priorities, while its close working relationship with public authorities promotes impactful research and solutions for policy making. Since CUSP's establishment coincided with a developing awareness at City government level about the importance of urban informatics and the integrated analysis of data from across agencies, it was able to align demand and supply of urban data and development.
- **Coordination and combination of urban data, developing data environments/data tools to treat and analyze data:** Since New York City provides selected open access to agency data, CUSP developed its competitive advantage in the innovative handling and treatment of existing data. It stores large data sets, integrates data sets from different sources to gain new information, cleans existing urban data sets to make them interoperable, provides tools to extract and treat data, and makes its tools and data infrastructure available to City agency staff. CUSP uses its data analysis capabilities to derive findings relevant for agency operations managers as well as policy makers and formulate strategic and practical recommendations.

However, the case study reveals the following **limitations** of this model:

- **Cost/Funding:** The funding model is one of the main challenges. Currently, the majority of funds come from tuition, sponsored research, and the core NYU budget. A better funding model for such a data infrastructure/center is needed, especially in view of transferability of the model to the European context.
- **Cooperation with academic and industrial partners:** The current cooperation with its partners in business and academia is in need of improvement. From the beginning, the strategy lacked mutually realistic expectations, a clearly defined role and strong commitment from its industry partners.
- **Personnel:** Since successful cooperation between CUSP and city authorities is dependent upon the right kind of staff, finding faculty and researchers that manage a suitable balance between scientific output and practical, real-world solutions is a challenge. On the one hand, CUSP needs its research staff to be interested in working with city authorities, understand urban problems, and be able to deliver pragmatic findings, solutions, and data tools to city authorities. On the other hand, faculty and other researchers must also be appropriately academically inclined and produce scientific results to satisfy traditional academic performance measures.

This case study builds on the ERA-LEARN 2020 "Definition and Typology of Alignment" and relies on a review of existing literature and a targeted interview. The case is part of a series investigating NOVEL approaches toward alignment.

ACKNOWLEDGEMENTS

This case study was written by Anna Wang and Susanne Meyer from the Austrian Institute of Technology (AIT). The authors are grateful to Michael Holland (Executive Director of CUSP). They would also like to thank the ERA-LEARN Consortium partners for their useful suggestions on earlier drafts of this case study.

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1. Introduction

This case study examines the key features, outputs, and overall strengths and weaknesses of New York University's Center for Urban Science and Progress (CUSP) with respect to the coordination of urban policy challenges and the research activities of a university. CUSP is a unique public-private research center, aiming to help municipal agencies meet increasing policy and service demands within highly constrained built and budgetary environments through academic research. CUSP's **approach of coordinating research, innovation, and policy interests of academia and city authority** to counter urban challenges is unprecedented and could serve as an inspiration for European P2Ps interested in setting up joint data and research infrastructures. CUSP utilizes its big data capabilities to integrate, analyze, and model a variety of data from across city agencies, and develops innovative data tools and infrastructure in order to devise practical, impactful findings and solutions to real-world urban challenges. The partnership between the CUSP and various city government agencies enables targeted, impactful research, while its industrial partners play a pivotal role in the commercialization and diffusion of solutions and technologies developed at CUSP.

2. Key features of CUSP

2.1 Overview

In order to expand New York City's research capacities in the applied sciences to diversify the local NYC economy, support the increasingly significant tech sector, and to maintain global competitiveness and job creation, the Bloomberg administration launched the Applied Sciences NYC program in December 2010. Its ultimate goal is to promote scientific research and the generation of innovative ideas that can be commercialized to increase the probability that the next Google will have its roots in the city. It issued a challenge to institutions worldwide to propose new or expanded applied sciences and engineering campuses in return for grants of city-owned land, development incentives from city capital, and the encouragement and partnership of the city government. In April 2012, New York University (NYU) and NYU-Poly's (renamed NYU Tandon School of Engineering in 2015) proposal for CUSP was the second bid to win approval to build a new applied sciences center in Downtown Brooklyn. CUSP is **a unique public-private research center and the proposal was the result of a consortium consisting of leading academic institutions, industry partners, and the City government**. These include, inter alia, Carnegie Mellon University, University of Toronto, City University of New York, IBM, Cisco, and Xerox¹.

For the first time in history, more than half of the world's population lives in cities. This number is expected to increase to 70 percent in the next decades. In this context, CUSP's **approach of coordinating research,**

¹ At the time of proposal, academic partners included Carnegie Mellon University, University of Toronto, University of Warwick UK, City University of New York, Indian Institute of Technology Bombay. Industrial partners included IBM, Xerox, Consolidated Edison, National Grid, Siemens, Arup, IDEO, AECOM. City government partners include Department of Transportation, Department of Buildings, Department of Sanitation, Department of Citywide Administrative Services, Department of Design and Construction, Department of City Planning, Department of Health and Mental Hygiene, Department of Environmental Protection, Department of Information Technology and Telecommunications, Department of Parks and Recreation, Police Department of NYC, NYC Fire Department, Metropolitan Transit Authority, Port Authority of New York and New Jersey. Microsoft, Lutron and the US Department of Energy Lawrence Livermore, Los Alamos, Sandia, Brookhaven National Laboratories were added later as partners.

innovation, and policy interests of academia and city authority to address the challenges is quite unique. New York City's government generates a terabyte of data every day about everything from traffic flows to electricity. CUSP has therefore signed a Memorandum of Understanding with the city to establish the concept of New York as a "living laboratory" by facilitating its work with City agencies to identify targets for research, to collect data, and develop and apply CUSP technologies and solutions to real world urban challenges. Its research, demonstration, and education programs are based primarily in the emerging field of urban informatics - the collection, integration, and analysis of big data to improve the operation of urban systems and enhance the quality of life. Since cities around the world face similar challenges regarding infrastructure, tech integration, energy efficiency, etc., results of CUSP research and development of technology will be relevant globally.

2.2 Mission and activities

The overall mission of CUSP is to help New York City and cities around the world to become more productive, livable, equitable, and resilient in the face of rapid urbanization and grow into the world's leading authority in the field of urban informatics.

- **Thematic Focus:** CUSP specializes in the field of urban informatics, the use of big data from a variety of sources to understand and address urban challenges. Although not part of a pre-defined strategy, it has a special focus and expertise in energy, environment, and transportation as a result of CUSP researchers and their relationships with specific City agencies and departments,
- **Embeddedness within NYU:** CUSP receives strong financial support from NYU. The university identified both urban and data science as principal themes in its strategy. Consequently, CUSP benefits from significant research budget allocations to develop this topic. It has access to resources of other schools and colleges within the NYU system, especially in terms of researchers and faculty. Faculty from other schools and disciplines teach at CUSP and are involved in CUSP projects. In return, the university expects CUSP to contribute to the overall performance improvement of NYU, measured with traditional indicators such as number of students enrolled, scientific publications, etc. It is also expected to contribute to increase the standing and reputation of the NYU Tandon School of Engineering.
- **Education and research:** In order for CUSP to achieve its goal of developing expertise and experts in the field of urban informatics, it is set up very much like a graduate school within NYU and offers Master's and certificate programs. Early on, CUSP was expected to grow to approximately 50 principal investigators (30 tenured and tenure-track faculty from NYU/NYU Tandon and other academic partners, and 20 research scientists from the industrial partners), 30 post-docs, over 400 Master's students, and 100 PhD students. More realistic growth targets are being evaluated.
- **Cooperation with city government:** CUSP is expected to produce impactful research and solutions for real-world city issues by scaling up tools for data treatment and utilization of urban data. Several factors contribute to the very good working relationship between CUSP and City agencies. 1) In 2013, New York City established the Mayor's Office of Data Analytics (MODA) to aggregate and analyze data from across City agencies. Additionally, the authorities established an internal data strategy for the City. This awareness of the importance of urban informatics on public authority level created an environment that facilitates the cooperation between CUSP and City agencies. NYU had a relatively easy time convincing the City of the importance and relevance of

CUSP. 2) Local law and local actions are complementary to and supportive of CUSP strategy and activities. For example, local law requires the City to publish its data on an open data portal, allowing CUSP access to a variety of urban data. The City's very professionalized bureaucracy is experienced in working with academic institutions and many agencies have cooperated with researchers and PhD students before.

- **Funding model and budget:** By August 2017, CUSP will occupy two of thirteen floors of a city-owned building, 370 Jay Street, which NYU received as part of its award to create CUSP. NYU is responsible for the costs associated with relocating prior tenants, estimated to amount to \$60 million, and for a complete renovation of the building, estimated in excess of \$200 million. To offset a portion of the costs of implementation, the city has allocated up to \$15 million in benefits to NYU, which includes development incentives and an abatement of amounts otherwise payable. Originally, CUSP's annual budget was projected to be approximately \$70 million, from sources that include federal, state, and City agency funding, corporate partner support, philanthropic donation, and tuition. Each of CUSP's industry partners were intended to provide \$150,000 in cash and up to \$850,000 of in-kind support annually, but that corporate membership model has not been realized successfully. Presently, CUSP's budget is approximately \$15 million annually, which is comprised of competitively-awarded sponsored research from federal agencies and private philanthropies as well as tuition revenue and a declining NYU subsidy.
- **Privacy of data and exclusiveness of access by CUSP:** New York City agencies are required by law to publish their data on an open portal by 2018, making it free and accessible for everyone. Thus, CUSP does not have exclusive access to City data and must rely on building competitive advantage based on available data. This includes, but is not limited to:
 - Building data discovery, exploratory data analysis and spatio-temporal search tools to treat open data
 - Developing tools and methods to move from data to data infrastructure (data environments, data protection (safety and security), combination of data)
 - Making CUSP data environment free to use for City agency staff and train staff to use it

3. CUSP outputs

In order achieve its mission, CUSP develops expertise and experts through its research, technology, and education programs. Specific activities and outputs include:

- **Research and technology activities:** CUSP executes a number of projects on many different scales. These range from large projects with defined scope/schedule/budget in partnership with the City and/or industrial partners to student-initiated projects. The National Science Foundation (NSF) is an important source of ex-ante or ex-post funding for CUSP research projects. Research projects conducted at CUSP are most successful when there is a high degree of coordination between faculty and researcher interests and agency engagement driven by the city's demands and preferentially implemented in a transdisciplinary way. The research team is often interdisciplinary, bringing together experts with backgrounds in the physical sciences, computer

science, engineering, or social and behavioral science to formulate the correct questions and to develop models and technology to inform those questions. Scholars and staff in the social and behavioral sciences from NYU and other academic partners, when appropriate, can become project team members. The following projects are successful examples of different types of CUSP research:

- **CUSP Urban Observatory:** In 2014, CUSP unveiled its first Urban Observatory, a demonstration project that uses a camera situated atop a building to quantify the dynamics of New York City by taking a panoramic image of Lower and Midtown Manhattan every ten seconds. Inspired by the toolkit of astronomy, it is the first of its kind and employs technology developed by CUSP scientists. Researchers use collected data to better understand and improve energy efficiency, releases of hazardous material, pollution, electricity provision, and more. The observations markedly differ from data gathered with a satellite, due to its unchanging perspective and easy and low cost operations. Currently only in operation in New York City, CUSP hopes to share the technology with other major cities in the future.
- **Sounds of New York City project (SONYC):** A 5-year comprehensive study on problems of urban noise to develop long-lasting policy and operational solutions in cooperation with researchers at NYU (Tandon, Steinhardt) and Ohio State University. By implementing SONYC, a cyber-physical system including a hybrid, distributed network of sensors and citizens armed with sound collecting and annotating apps, the project aims to monitor noise pollution, accurately describe acoustic environments, broaden citizen participation in noise reporting and mitigation, and enable city agencies to take effective action. Relying upon supervised machine-learning algorithms with processing at the edge of the network, SONYC analyzes, retrieves, and visualizes the data and makes it available to decision makers at city agencies, thereby facilitating strategic deployment of resources.
- **Establishment of “Quantified Communities”:** CUSP’s ambition is to create three fully instrumented urban neighborhoods that measure and analyze key physical and environmental attributes such as pedestrian flows, air quality, and solid waste. The Quantified Community essentially creates an experimental environment and acts as testing ground for new physical and informatics technologies and analytics capabilities. The resulting data and studies are designed to help communities identify and solve problems and serve as a basis for future sustainable urban development. This is being realized through:
 - The Neighborhood Innovation Labs - a partnership between the Mayor’s Office of Technology and Innovation, NYC Economic Development Corporation, CUSP, and neighborhood-based organizations. The purpose is to bring together public officials, citizens, educators, tech companies, and other stakeholders to solve local problems through data analysis, apps, sensors that monitor neighborhood resources, and Internet of Things devices.
 - Related Companies - Hudson Yards, a large-scale, multi-building residential and commercial project under construction over the next 10 years in midtown Manhattan.

- Red Hook Initiative – Piggybacking on the WiFi network established by RHI in Red Hook, Brooklyn, CUSP has begun a pilot sensor deployment.
- **Education of Master’s and certificate students:** CUSP offers a one-year Master of Science program in Applied Urban Science and Informatics as well as an Advanced Certificate option. These programs began operation in 2013, welcoming its first class of some 23 students. By July 2017, CUSP will have graduated more than 200 Master’s students.
- **Training:** CUSP offers training for City agency staff, particularly in the use of its data infrastructure and tools.
- **Data capabilities and activities:** The acquisition, organization, integration, and analysis of large heterogeneous datasets (big data) is at the core of CUSP’s functions as well as the emerging field of urban informatics. Examples include: creating an urban observatory to collect data, data modeling and simulation, etc. Since its establishment, CUSP has gathered and made available large amounts of data to other researchers, thus stimulating research and solutions in issues relating to urban infrastructure, mobility, urban engineering, urban systems operation, urban planning, etc. CUSP data and studies simultaneously act as a basis for informed decision making by city agency officials. Beyond the analysis of newly acquired data, CUSP also develops and scales up tools for data treatment and the utilization of urban data.
- **Impact on cities:** CUSP devises and demonstrates new technology through its research and educational programs. These technologies and tools for urban data treatment and storage could be scaled up and utilized by CUSP and/or city authorities (and commercialized, through CUSP’s industrial partners and startups created on-site).
- **Coupling demand and supply side of urban development and create impact:** CUSP’s work aims to not only be relevant but also impactful to urban challenges and problems. Above all, its research outputs and technology are based on understanding how to best promote the adoption of new technologies by city agencies. Its special relationship to many New York City government agencies facilitates impactful research and technology development.
- **Guidance and transfer of basic principle of CUSP to other countries:** NYU CUSP, King’s College London, and the University of Warwick are establishing a Center for Urban Science and Progress London to be based at King’s College London. It is scheduled to launch later this year and marks the first expansion of the CUSP model.

4. Overall strengths and key achievements of CUSP

CUSP employs its big data capabilities to tackle policy questions and demands posed by rapid urbanization from a new, integrated angle. In this process, it achieved success by managing to coordinate demand and supply of urban data science to produce impactful research findings, solutions, and tools. The following are key strengths and achievements of the CUSP approach:

- **Enhanced inter-institutional cooperation between academic institutions & academia and city government:** CUSP works closely with its academic partners worldwide, thus coordinating thematic priorities. Researchers from different institutions and different disciplines participate in research projects. CUSP also develops experts that can work inter- and transdisciplinary by having

PhD students and post-docs from different disciplines work and study on-site and by conducting projects in close partnership with city agencies. CUSP has also proven to be a successful instrument to enhance the cooperation between academia and city authorities. Its close working relationship with public authorities promotes impactful research and solutions for policy making. Since CUSP's establishment coincided with the developing awareness at City government level of the importance of urban informatics and the integrated analysis of data from across agencies, it was able to match demand and supply of urban data and development. Beyond the official partnership between CUSP and City agencies, faculty and researchers also built a close relationship with certain agencies and departments.

- **Coordination and combination of urban data, developing data environments/data tools to treat and analyze data:** Since New York City provides open access to agency data, CUSP developed its competitive advantage in the innovative handling and treatment of existing data. It stores large data sets, integrates data sets from different sources to gain new information, cleans existing urban data sets to make them interoperable, and provides tools to extract and treat data. CUSP then makes its data tools and infrastructure free to use for City agency staff. It uses its data analysis capabilities to derive findings relevant for policy makers and formulate strategic and practical recommendations. A priority is the formulation of the right questions to target real urban problems at the beginning of a project.

5. Overall limitations and challenges

Although CUSP has experienced tremendous success in its innovative approach as a public-private research center, its model exhibits a number of weaknesses and limitations described in detail below:

- **Cost/Funding:** The funding model is one of the main challenges. While the city and industrial partners contribute marginally to CUSP's annual budget, the majority of funds come from tuition, sponsored research, and the NYU budget. The City has allocated up to \$15 million to NYU in energy benefits, sales tax exemptions, and other tax benefits to assist with redevelopment of the building, leaving the financial responsibility for funding CUSP to the university. This funding structure is feasible only in the context of the US academic system and NYU's scale as the nation's largest private university. The scalability of the Masters' degree in urban informatics has also been a challenge. A better funding model for such a data infrastructure/center is needed, especially in view of transferability of the model to the European context.
- **Cooperation with academic and industrial partners:** CUSP was founded on the basis of a partnership between NYU and its government, academic, and industrial partners. However, the cooperation with its business partners could be strengthened in the future. From the beginning, the strategy lacked a clearly defined role and strong commitment from its industry partners. Another challenge is the need to strengthen the cooperation with other universities within the CUSP consortium.
- **Personnel:** It is often the case that some faculty members perceive the tackling of problems of city agencies as work to be taken up by consultancies instead of CUSP. Since successful cooperation between CUSP and city authorities is dependent upon the right kind of staff, finding

faculty and researchers that manage a suitable balance between scientific output and practical, real-world solutions is a challenge. On the one hand, CUSP needs its research staff to be interested in working with city authorities, understand urban problems, and be able to deliver pragmatic findings, solutions, and data tools to city authorities. On the other hand, faculty and other researchers must also be appropriately academically inclined and produce scientific results to satisfy traditional academic performance measures that determine career progression and success in competitions for sponsored research funding.

6. Conclusions: Key success factors of CUSP and transferability

CUSP has successfully established a model to enhance **cooperation between academia and city authorities**. It demonstrated that universities and faculty can contribute to practical solutions to urban policy challenges by developing interdisciplinary research and applying a transdisciplinary approach and innovative data analysis and modeling tools. CUSP's experience reveals that constant monitoring and evaluation is needed in the set-up phase to adjust to unforeseen or changed circumstances such as challenges to the funding model or evaluating more realistic growth targets due to challenges to the scalability of the Master's degree program. Its external advisory board generally meets twice a year where the board receives reports on overall strategy as well as progress on education, research, and financial matters. Each board meeting concludes in a closed session with representatives of the Provost's office. Coincident with the reappointment of all Deans and Directors at NYU, a 5-year external review charged and managed by the Provost's office took place at the beginning of May 2017. The external review committee spoke to the leadership of CUSP, faculty, students, and staff as well as other NYU and NYC agency stakeholders.

In the right context, the **transferability of the CUSP model is high**. However, introducing a research center based on the CUSP model in Europe would require a drastically adapted financing model as one European university on its own will most likely not have the funds required to support operations. Realistically, several European universities could join efforts in partnership with several regional and city authorities with clearly defined roles for other partners and strong commitment of industrial partners. Building such a research infrastructure could benefit from a transnational approach, therefore this example might be interesting for European P2Ps. The section below details other indispensable success factors for the establishment and operation of an impactful research center.

1) At university level

- **Strong institutional support of NYU to realize CUSP.** The university was fully committed, especially financially, from the beginning and set up CUSP as a Provostial unit within NYU.
- During the start-up phase, the **governance structure** was a strong Director model with strategic decision-making powers vested in the Director. As CUSP matured and built its faculty, it is now slowly moving towards a more traditional faculty governance model.
- **Connecting the research strategy of NYU, research budget allocation, and research infrastructure** at NYU to support the establishment and successful operation of CUSP.

- **CUSP's ability to draft faculty members from across NYU schools and disciplines** into CUSP research, teaching, and projects. The same applies to PhD students and post-docs, educating a generation of researchers with inter- and transdisciplinary skills.
- **Good working relationship between faculty members and staff in city government** primarily through finding and developing a **common language and establishing mutual interest**. Faculty must be interested in understanding and solving urban problems, and explaining and communicating findings to city authorities in a non-academic manner. City agency staff must also be interested and willing to invest time in elaborating their problems to researchers and understanding the findings and recommendations of CUSP. The city's very professional government bureaucracy contributes to the positive relationship. Many **city agencies already have significant experience in working with researchers** and graduate students.

2) *At city level*

- **Local NYC law and actions complement and support CUSP strategy and activities very well**. City authorities are required by law to provide **open access to a variety of urban data**. Around the time of CUSP establishment, data science was a hot topic among researchers and cities and NYU did not need to convince the city of the importance and relevance of urban informatics. NYC established the Mayor's Office of Data Analytics and an internal data strategy for the city. Thus, CUSP manages to **unite the two institutions, academic and city authorities, for whom data science was high on the agenda**.
- **Staff mobility between NYC government departments and CUSP**. Since the opening of CUSP, staff previously working in various city agencies have joined the CUSP team, including several city employees who have served as adjunct instructors. This ensures a deep, applied understanding of the city's problems at CUSP and fosters reliable, stable relationships between city authorities and CUSP.
- **High level of awareness about CUSP on government level** especially through substantial press coverage at the beginning. It helped raise attention and promote the existence of CUSP and encouraged agencies and staff to work with it.

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