OPEN APPROACHES FOR SMART GOVERNMENT: IMPULSES FROM GERMANY

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This article introduces the concept of smart government. It discusses existing misconceptions, relates it to the term artificial intelligence and the label 4.0. Subsequently, the technological foundations – smart object and cyber-physical objects – are described. Smart government is then defined by taking into account existing approaches from science. The article further discusses implications for administrations. A vision for smart government is delineated by offering a scenario for a fire department. Based on this, a SWOT analysis for smart government is conducted to encourage the implementation of the concept. Open approaches for smart government are a major key of success for the realization. Finally, the German City of Ulm is presented as a city on its way to becoming a smart city with a smart government.

§ 1 – SMART MEANS INTELLIGENT NETWORKING

In the discussion about the reform of political processes, governments, and administrations, digitalization has become more and more important. Information and communication technologies have enabled the rise of electronic processes in e-government. They have also created a vast potential for increased transparency, participation, and collaboration as is summarized by open government. The next level of digital government reform will be smart government. On the subsequent pages, this article[1] will introduce the concept of smart government and delineate a vision for its implementation. However, in order to do so, some clarifications are necessary. Therefore this article will begin by discussing the meaning and misconception of the phrase "smart" before explaining its technological foundations. It will then introduce a scenario for smart government and a SWOT analysis of the

[1] The presentation in the Workshop "Smart Cities & Open Government" at the Academic Day on Open Government Issues IMODEV 2016 in Paris (https://www.zu.de/info-de/institute/togi/assets/pdf/JvL-161205-PRE-Smart-Government-OGP-Paris-V2.pdf) and this article is partly based on J. VON LUCKE, *Smart Government – Wie uns die intelligente Vernetzung zum Leitbild „Verwaltung 4.0" und einem smarten Regierungs- und Verwaltungshandeln führt* (Zeppelin Universität 2015) and J. VON LUCKE, *Smart Government - The Potential of Intelligent Networking in Government and Public Administration*, CeDEM16 - Conference for E-Democracy and Open Government (IEEE Computer Society 2016).

concept. Additionally, it shows options for open approaches for the implementation of smart government. Finally, the article will illustrate the case of the German City of Ulm on its way to becoming a smart city with a smart government.

A) A Smart Misconception

The word "smart" has become a globally recognized label for the next wave of digital development. In the majority of cases however, it is merely used as a new denominator, a new label to replace e-government or open government, without any awareness for the concepts that "smart" actually encompasses. "Smart" is also utilized as a synonym for "clever", "cute" and "brilliant", for example by former US President Bill Clinton who formulated this in his 2011 published book "Back to Work: Why We Need Smart Government for a Strong Economy."[2]

At its core however, "smart" signifies the intelligent networking of existing objects and networks. Their functionality is enhanced through IT systems. They receive a virtual identity and are connected to the Internet. This enables them to communicate directly with other virtual objects and to be accessed and steered remotely. This small technical extension releases an enormous potential for change that should not be diluted by using "smart" to describe generic digital strategies using broadband, the latest hardware and software or new apps and information systems. Rather, "smart" describes the creation of a vast network of interconnected smart objects and cyber-physical systems (CPS), which will be elaborated on in the subsequent section. This can of course and certainly will lead to better, cleverer decisions.

B) Smart Does Not Mean Artificial Intelligence

The term "intelligent networking" should not be confounded with the terms "networked intelligence" or "artificial intelligence". Intelligent networking is defined by real or virtual objects, communicating with each other over a distributed network. They evaluate sensor data and initiate actions on demand. The underlying decision logic is usually simple and not comparable to human intelligence. The term "networked intelligence" puts people and their intelligence in the center, connecting a group to achieve common goals by means of computer networks and information systems. It is thus about IT-based forms of collaboration such as crowd sourcing, open knowledge management or approaches for open societal innovation[3]. "Artificial intelligence" describes IT systems that can behave intelligently like a human being. Of course, all objects with artificial intelligence might be intelligently connected.

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[2] B. CLINTON, *Back to Work: Why We Need Smart Government for a Strong Economy*, New York City, Knopf Doubleday Publishing Group, 2011.

[3] J. VON LUCKE, *Open Government Collaboration – Offene Formen der Zusammenarbeit beim Regieren und Verwalten*, Friedrichshafen, Zeppelin Universität, 2012, p 14.

C) Smart Means 4.0

Another common denominator to describe "intelligent networking" is the version reference "4.0". It was first used in Germany to describe the next level of industrial production "Industrie 4.0" (Industry 4.0), which uses smart objects and CPS. 4.0 can thus be seen as the next wave of industrial revolution, with 1.0 indicating the advance of mechanization, the "power loom", and steam-powered engines. With electricity came the second revolution, leading to the automation of work and production line assembly. Computers meant the advance of the third revolution. Smart objects and CPS mark the fourth wave of change.
Another explanation that links smart and 4.0 are the version numbers of the web. In its first version, the web was dominated by machines and one-way information provision. Its second version came with the advance of social media and easy-to-use services to upload text, photos, and videos, giving rise to user-generated-content. The web 3.0 can be called semantic web, the web in which large amounts of data are linked and can provide answers to specific questions – as assistants like Siri or search engines like WolframAlpha illustrate. The web 4.0 is the Internet of Things and Services, the smart web of smart objects and CPS.

§ 2 – SMART OBJECTS AND CYBER-PHYSICAL SYSTEMS

Smart objects are advanced devices of everyday life that are equipped with sensors, actuators, and a communication unit. A unique identity on the Internet and a virtual representation make them addressable to humans or other smart objects. As soon as these objects interact with each other or with people, they are colloquially awarded a "certain intelligence" or "smartness", even if thinking skills and wisdom are not present. This is the origin of the term "smart objects". In everyday life, an increased smartness of popular objects can already be observed. Former stand-alone devices are equipped with advanced functionality, better sensors, a variety of response options, and a wireless broadband connection to the Internet. Cell phones become "smart phones", televisions "smart TVs" and watches "smart watches". This intelligent networking of objects now encompasses cars and trucks, ships, aircrafts, machines, and factories.
If required, these smart devices can embed in so-called cyber-physical systems (CPS), which network physical objects with digital information and communication systems. An intelligent networking of smart objects and their interaction can be guaranteed this way[4]. CPS can gather data, analyze it and initiate task execution for which they use interconnected smart objects, em-

[4] Acatech, *Cyber-Physical Systems – Driving force for innovation in mobility, health, energy and production*, Heidelberg, Springer Verlag, 2011, p. 13; E. GEISBERGER, M. BROY, *agendaCPS – Integrierte Forschungsagenda Cyber-Physical Systems,* acatech Studie, München/Garching, acatech – Deutsche Akademie der Technikwissenschaften e.V., 2012, p. 22.

bedded systems or sensor networks. Due to global interconnectedness, CPS can operate on large scales and overcome geographic distances. Powerful CPS almost instantaneously detect changes in the environment of their respective smart objects and adapt their behavior accordingly. CPS are thus able to react to specific situations, interact with users, and thereby influence their behavior[5]. Based on this concept, smart ecosystems can be developed, in which IT systems, people, data, things, and services will equally be involved and which will be able to inform, analyze, monitor, and control themselves. This networking via the Internet causes an increasingly seamless integration of the analogue world and the digital world[6].

Technically this "smart world" is the application of the Internet of Things and the Internet of Services in the real world. The Internet of Things is the result of the global "electronic networking of everyday objects"[7] via the IP-suite and the direct exchange of information between objects without human intervention in the sense of genuine machine-to-machine communication. In the Internet of Services, functionality and services are delivered as fine-grained software components and made available on-demand by providers over the Internet. Web services, cloud computing, and standardized interfaces facilitate this. Intelligently connected real and virtual objects operate in self-controlled (smart) ecosystems. This constitutes a significant difference compared to the previous approaches: Smart objects and CPS do not only support in information and analysis. They can also take over automation and control processes autonomously and independently from humans[8]. This gives rise to opportunities, but also risks and challenges that need to be taken into account.

Smart objects and CPS have already significantly influenced industrial production and operations, as is recognized by the term "Industry 4.0". Some even argue in favor of using "Economy 4.0", to accentuate the disruptive potential of these technologies for the entire sector. Governments should not ignore this change. Not only do they need to prepare for a changing economy. They should also exploit the potential of 4.0 for their own processes.

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[5] E. GEISBERGER, M. BROY, *agenda CPS – Integrierte Forschungsagenda Cyber-Physical Systems,* acatech Studie, München/Garching, acatech – Deutsche Akademie der Technikwissenschaften e.V., 2012, p. 22.

[6] J. VON LUCKE, *Smart Government – Wie uns die intelligente Vernetzung zum Leitbild „Verwaltung 4.0" und einem smarten Regierungs- und Verwaltungshandeln führt,* Whitepaper, Friedrichshafen, Zeppelin Universität, 2015.

[7] Bundesministerium für Bildung und Forschung, *Zukunftsbild „Industrie 4.0"*, Berlin, 2013.

[8] M. CHUI, M. LÖFFLER, R. ROBERTS, "The Internet of Things", *The McKinsey Quarterly*, vol. 47, n° 2/2010, pp. 1-9.

§ 3 – SMART GOVERNMENT: DEFINITION AND IMPLICATIONS

A) Existing Approaches and Definitions

To summarize, this paper is proposing to keep using "smart" in combination with "government" to describe the next level of digital public sector modernization. However, the term should be used to describe approaches that include smart objects and CPS, going further than a mere e-government or government 2.0 strategy.

There are some existing approaches to smart government. In 2009 the Emirate of Dubai created the "Dubai Smart Government Department"[9], with responsibilities for the full range of government information management and electronic government services, including smart government applications. It also integrates smart government initiatives. Since 2000, Dubai experiments with sustainable smart technologies for the urban environment.

When it comes to the definition of smart government, the market research firm Gartner describes it as the integration of information, communication, and operational technologies to exercise the planning and management of operations across multiple domains, process areas, and jurisdictions to generate sustainable public value.[10] It places the Internet of Things among the top ten of the most relevant technology trends. Other definitions however, neglect the aspect of smart objects and CPS. The market research and consulting firm International Data Corporation (IDC) defines smart government as "the implementation of a set of business processes and underlying information technology capabilities that enable information to flow seamlessly across government agencies and programs to become intuitive in providing high quality citizen services across all government programs and activity domains."[11] The associated "smart government maturity model"[12] rather deals with e-government and open government.

Anthopoulos and Reddick compile an overview over definitions of smart government that shows that also in science, the term lacks clear conceptualization[13]. Smart Government is described as the next step for e-government and open government. It is thought to be a reaction to an increasingly complex environment in which problems need to be solved by creating innovation through novel information technologies. Exchange and collaboration in between government agencies seems to be a key factor.

[9] http://www.dsg.gov.ae.

[10] Gartner Inc., *Gartner Identifies the Top 10 Strategic Technology Trends for Smart Government*, Dubai, 2014.

[11] T. RUBEL, *Smart Government – Creating More Effective Information and Services*, Framingham, International Data Corporation (IDC), 2012, p. 2.

[12] *Ibidem*, p. 10.

[13] L. G. ANTHOPOULOS, C. G. Reddick, *Smart City and Smart Government: Synonymous or Complementary?*, Companion of the 25th International World Wide Web Conference, 2016, pp. 351–355.

Jimenez et al. describe smart government as government in the "interconnected 'ecosystem'" of a smart city[14]. They also accentuate that there is "no smart government without open government."[15] The authors later specify that a key element of smart cities, and therefore smart government, is amongst others the networking of sensors and software, enabling machine-to-machine communication. Be that as it may be, they do not provide a comprehensive definition of smart government.

In Germany, the Federal Government has been promoting research activities on the Internet of Things and the Internet of Services for business and industry since 2006. But only since 2015 it is obvious that research is also needed for an intelligently networked government: The initiative "Intelligent Networking") for the sectors education, energy, health, transport and administration (Initiative Intelligente Vernetzung[16]) and the contest "City of the Future" (Wettbewerb Zukunftsstadt[17]) were initiated to gather exemplary solutions together with citizens, develop visions and set up implementation concepts.

This shows clearly that while the term "smart government" is still not widely used in Germany, there is a need to define the concept. This holds true especially in the light of many confounding interpretations that present smart government as merely a new label to better, more innovative, open government. Germany and other countries need a common understanding of smart government that includes smart activities and smart technologies.

B) Defining Smart Government: Smart Means Networked and Open

Based on the above considerations, the subsequent "Definition of Smart Government" is proposed, which was originally formulated in September 2015[18] and that is graphically represented in Figure 1. It is grounded on the well-known German Speyerer Definition of e-Government[19].

> "Smart Government should be understood as the management of business processes related to government and administration with the help of intelligently networked information and communication technologies (ICT). Intelligently networked governance uses the

[14] C. E. JIMÉNEZ, F. FALCONE, A. SOLANAS, H. PUYOSA, S. ZOUGHBI, F. GONZÁLEZ, "Smart Government: Opportunities and Challenges in Smart Cities Development – An IT & Public Organization Approach", in □. DOLI□ANIN, E. KAJAN, D. RANDJELOVI□, B. STOJANOVI□ (eds.), *Handbook of Research on Democratic Strategies and Citizen-Centered E-Government Services*, Hershey, IGI Global, 2015, pp. 1-19.

[15] *Ibid.*, p. 3.

[16] http://www.bmwi.de/DE/Themen/Digitale-Welt/initiative-intelligente-vernetzung.html.

[17] https://www.wettbewerb-zukunftsstadt.de.

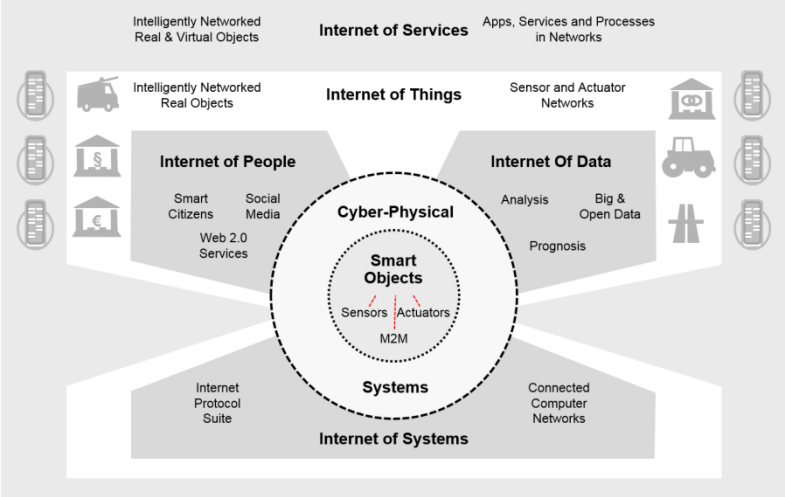
[18] See in German J. VON LUCKE, *Smart Government – Wie uns die intelligente Vernetzung zum Leitbild „Verwaltung 4.0" und einem smarten Regierungs- und Verwaltungshandeln führt,* Whitepaper, Friedrichshafen, Zeppelin Universität, 2015, p. 4.

[19] J. VON LUCKE, H. REINERMANN, *Speyerer Definition von Electronic Government*, Speyer, Forschungsinstitut für öffentliche Verwaltung, 2000, p. 1.

opportunities of interconnected smart objects and cyber-physical systems for the efficient and effective performance of public tasks. This includes the portfolio of e-government and open government, embracing big data and open data. At its core, it is about sustainable government and administrative actions in the age of the Internet of Things and the Internet of Services, whose technical foundation is on the Internet of Systems, the Internet of People, and the Internet of Data. This definition includes the local or municipal level, the regional or provincial level, the national or federal level as well as the supranational and global level. Included is thus the entire public sector, consisting of legislative, executive and judiciary as well as public enterprises."

The central idea of smart government of Jimenez-Gomez et al. is reflected in this comprehensive approach to an intelligently networked public administration. Open government therefore should be seen as part of smart government[20].

Figure 1: Smart Government Arranged Around Smart Objects and Cyber-Physical Systems



C) Implications for Administrations

The effect of intelligently networked objects, cyber-physical systems, the Internet of Things, and the Internet of Services will substantially change politics, administration, economy, and society. Many objects of everyday life can be enhanced and re-shaped by the means of addressable processors, sensors, and actuators. Most paper-based processes can be set up and handled

[20] C. E. JIMÉNEZ, F. FALCONE, A. SOLANAS, H. PUYOSA, S. ZOUGHBI, F. GONZÁLEZ, "Smart Government: Opportunities and Challenges in Smart Cities Development – An IT & Public Organization Approach", in □. DOLI□ANIN, E. KAJAN, D. RANDJELOVI□, B. STOJANOVI□ (Eds.), *Handbook of Research on Democratic Strategies and Citizen-Centered E-Government Services*, Hershey, IGI Global, 2015, p. 1-19.

much more efficiently via electronic files and workflow management systems. The exchange of data and the co-operation in and between agencies that smart government entails will also lead to changes in the organization and structure of administration. This calls for a concretization of the possibilities that smart government offers for politics and administration. What are possible visions and scenarios for intelligently networked political activities ("Smart Politics"[21]), an intelligently networked legislation ("Smart Legislation") and intelligently networked state agencies ("Smart Administration"), for smart decisions, and smart civil servants[22]? Also, the broader perspective of smart citizens in smart cities should not be neglected. Additionally, guiding principles for dealing with the Internet of Things and the Internet of Services in state, administration, and society are needed in order to carefully handle potential risks and provide the necessary security and protect privacy.

From the perspective of public sector informatics and business informatics, until now the opportunities and risks of smart government have neither been systematically captured nor comprehensively developed. Although in the context of "smart cities" there are already diverse thoughts about smartness in energy, health, transport, and education networks[23], concrete applications of smart technologies are rarely discussed for the core areas of public administration. As one of the first examples a scenario for a fire department[24] is presented in the subsequent section. This first scenario serves as a stepping stone for a general SWOT analysis of smart government. The section is rounded off with a case description of the Germany City of Ulm on its way towards becoming a smart city with a smart government.

§ 4 – SMART GOVERNMENT: VISION AND IMPLEMENTATION

A) Smart Government Scenario: Fire Department 4.0

The volunteer fire brigade as well as the professional fire department counter several dangers to body, life and property in cases of fires and explosions. They also help in cases of flooding, accidents and collapses. Additionally, they take care of the preventive fire protection in buildings. To some extent, they also take over the tasks of rescue and hospital transport services.

Intelligently networked objects such as smoke detectors, smartphones, surveillance cameras and drones can support the work of

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21 S. NOVOSELIC, *Smart Politics*, TOGI-Schriftenreihe, vol. 17, Berlin, ePubli GmbH, 2016.

22 F. KEPPELER, "Der smarte Beamte", *Kommune 21 – E-Government, Internet und Informationstechnik*, vol. 16, n° 1/2016, pp. 24-25.

23 E. GEISBERGER, M. BROY, *agenda CPS – Integrierte Forschungsagenda Cyber-Physical Systems,* acatech Studie, München/Garching, acatech – Deutsche Akademie der Technikwissenschaften e.V., 2012.

24 Originally published in German in J. VON LUCKE, *Smart Government – Wie uns die intelligente Vernetzung zum Leitbild „Verwaltung 4.0" und einem smarten Regierungs- und Verwaltungshandeln führt,* Whitepaper, Friedrichshafen, Zeppelin Universität, 2015, p. 26.

the fire department, for example when fighting fires and monitoring neighbor buildings. The integrated sensors automatically detect certain conditions and report them to the control center. Smart firefighter glasses and displays in helmets provide emergency personnel with additional information and predictions that provide guidance for example in the search for the fire alarm center of a building. This provides valuable support in an emergency situation. Smart clothing and other wearables can quickly alert in dangerous situations.

Table 1: Smart Fire Department

Information and Analysis	Automation and Control
Tracking Behaviour	Process Optimisation
Detection & localization of rescue teams: wristband, clock, smart phone & wearables Surveillance drones to monitor and measure risk & fire situations	Rapid geo-location and control of emergency services in case of an emergency Requirement of special forces when needed Warning in cases of major disasters
Enhanced Situational Awareness	Optimised Resource Consumption
Smart firefighters glasses and helmets with information to the site, the risk situation and application control Evaluation of the fire alarm control panel	Management planning and usage forecast Smart rescue mission headquarter Tablets with information & apps for usage Smart fire hose
Sensor-driven Decision Analytics	Complex Autonomous Systems
Intelligent clothing with warning function for dangerous heat and gas concentration Analysis on the existing hazards with timely proposals for risk elimination	Control of people flows for major events and major catastrophes Autonomous robots and drones for dangerous rescue missions

Fire departments 4.0 will be increasingly focusing on cyber-physical systems, such as fire protection systems, for the control of the operational forces. Emergency rescue teams and security staff can be directly detected and geo-located as well as remotely controlled in large-scale emergency situations. Smart assistants support on-site. People are better prepared for challenging and unpredictable situations. Autonomous robots and drones could also be used wherever it is too dangerous for humans.

Rescue workers and firefighters benefit from touchpads and smart glasses, because they can prepare themselves for their mission and the risks while traveling to the site. There are apps, for example, which provide information on where a liberating rescue section has to be taken on an accident vehicle in order to save human lives as quickly as possible. Apps use existing maps, geo-information systems, databases and reference books, select relevant information and thus facilitate planning and decision-making. The right information base can save people's lives.

B) Consequences for Smart Government

The diverse smart approaches for smart fire departments outlined here refer to several new design options for the public sector, based on the intelligent networking via the Internet of Things and the Internet of Services. Looking at the wide variety of the public sector and of public tasks, there are numerous further scenarios for smart government in different sectors. Consequently, on one hand smart objects have to be designed with more innovative solutions compared to the previous simple objects. On the other hand, smart government is about the complete redesign of paper-based processes with digital record and workflow management systems, for example relying entirely on virtual objects. As part of his studies, the author has developed further scenarios for "Court of Justice 4.0", "Tax Administration 4.0", "Registry Office 4.0", "Agriculture Administration 4.0"and "Construction Administration 4.0"[25], which are starting points for further discussions, detailed concepts, prototype developments and smart government solutions.

All this serves the purpose to raise awareness for the upcoming changes towards smart government that are triggered by the Internet of Things and Services. In a global context, this development can hardly be stopped. Consequently, it is more about when, in what areas, in what form, and in what proportions cyber-physical systems will change the public sector. In the interest of an overall positive development, it is important to know the related strengths and weaknesses, opportunities and threats (see table 2). This enables the selection of appropriate focus points in the public sector, realize where it makes sense to explore opportunities in pilot projects potentials to identify benefits, challenges, and limitations, and to design solutions for the benefit of the society.

[25] J. VON LUCKE, *Smart Government – Wie uns die intelligente Vernetzung zum Leitbild „Verwaltung 4.0" und einem smarten Regierungs- und Verwaltungshandeln führt,* Whitepaper, Friedrichshafen, Zeppelin Universität, 2015, pp. 16-30.

Table 2: SWOT-Analysis for Smart Government

Strengths	Weaknesses
Integrative IP-based approach Intensification of networking Vision: Smart Agencies Vision: Smart Politics Vision: Smart Civil Officers Vision: Smart Citizens	Development needs effort and time Required financial expenses Insufficient scientific foundation Research & development capacity Sensor-data enables behaviour tracking Insufficient political prioritization
Opportunities	**Threats**
Innovation potential and impulses Novel intelligently networked objects Novel intelligently networked services Innovative cyber-physical systems Increases in efficiency & effectiveness Cost and fee reductions	Lack of design readiness Uncertainty vs. winning implementation Disruptive nature of changes Lack of permanent funding Lack of acceptance and participation Strategic exploitations of fears of transparency

C) Strengths and Opportunities of Smart Government

Firstly, the internet protocol (IP) has proven to be highly integrative. It has ensured worldwide Internet adoption and global spread of its applications. Smart Government solutions, being based on the same protocol, are equally scalable and can integrate existing solutions. Secondly, the implementation of smart government does inherently require the intensification of networking; on the one hand, the networking of agency systems with data, virtual object, and stakeholders; on the other hand, the networking of agency amongst themselves, meaning their systems and services. This will lead to leaner, more efficient, and effective service provision. Thirdly, if states actively embrace the concept of smart government they will develop their own visions for "smart agencies", "smart politics", "smart civil officers", and "smart citizens", which will significantly contribute to steering society, economy, and administration through these changes successfully. Such visions provide orientation and room for debates, even about ethical boundaries, ideas, objectives, implementation strategies, and concrete actions.

The greatest opportunity lies in the potential of smart government to trigger further innovations. Not only existing smart objects could be used for the performance of public tasks. Entirely

new smart things and services, particularly cyber-physical systems, could be designed for the public sector, which offer public services more efficiently and to some extent more effectively. Administration, science, and business need to be partners in this development, combining engineering and public management knowledge. After all, it is about the design of smart objects, processes, and services, their networking, and smart control in their respective environment. Of course, this has to be done under the consideration of politically predefined goals such as the rule of law, increased efficiency, effectiveness, and individualized services, reduced workload for public employees, cost reductions, as well as improved control over tasks and expenditure. As a consequence, citizens and enterprises can be provided with an improved range of public services, which should be characterized by a further acceleration, lower fees, individuality, and reliability. The assistive features of many smart government systems also help to relieve the administrative staff's workload. However, these opportunities must be recognized and realized.

D) Weaknesses and Threats Looming on the Horizon

Right now, a major weakness of smart government is that there are neither comprehensive concepts nor detailed smart government solutions available that introduce specific smart objects and cyber-physical systems for a more effective performance of public tasks. Therefore, all upcoming sketches, designs, developments and implementations have to be associated with significant time, labor, and financial investments. Additionally, the scientific exploration of this new field of research has just begun worldwide. Another particularly critical point is that the sensor data generated by smart objects enables the global monitoring of people, objects, services, and data. Movements and interactions could be evaluated at any time. Business models and monitoring systems could even be based on such behavioral data collections. These approaches do not only include search term inquiries, tracking services, and reports by the users themselves. The Internet of Things also offers third parties innovative ways for exploiting anonymous or personalized data. States wishing to regulate these activities must consider various aspects, in particular the challenges of sensor-based decision analysis and an increasingly computer-controlled automation and control[26]. As soon as possible, politics and administration have to create a framework for a secure and trusted data, information, and communication infrastructure, barring access for foreign intelligence services, criminals, and the armies of potential enemies. In times of tight budgets and human resources, these are important issues, which might hinder the discussion about smart government, the Internet of Things, and related re-

[26] M. CHUI, M. LÖFFLER, R. ROBERTS, "The Internet of Things", *The McKinsey Quarterly*, vol. 47, n° 2/2010, pp. 3-9.

forms, especially if governments do not attribute them a high priority.

The road to smart government is also associated with threats, which make a successful implementation more than uncertain. Despite the willingness to change, creativity and willpower are limited resources. The state of science, technical limitations such as network coverage, bandwidth and standardization, the availability of competent thinkers, and financing constraints will define short, medium and long-term limits for all states. Each implementation of a smart government concept for a specific department also has to deal with the typical legal, technical, organizational, financial, strategic, and political challenges. There are also openly articulated concerns about risks and cultural difficulties caused by the disruptive nature of the changes that smart government causes. This might lead to a lack of acceptance and thus reduced use of smart government processes. Unions and parties will have to be factored in as an important player. They will want to enforce the interests of civil servants, workers and citizens. They might even use the looming fear of total transparency to improve their negotiating position. Therefore, and already at an early stage, a comprehensive change management is required for a successful implementation of smart government.

§ 5 – Open Approaches for Smart Government

Right now in the beginning, it is very important to think about how open approaches would help to introduce and to improve smart government. Why should the administration not open all the data generated by millions of smart government sensors? Open-by-default for these sensors would be a clever proposal to push the open data agenda. Smart government also opens new opportunities for further level of developments: Transparency 4.0 means new forms of transparency by smart objects and cyber-physical systems. Participation 4.0 would offer new opportunities and approaches for contributions in the political process, but also leads to an uncontrolled rise of social bots and disinformation robots. Collaboration 4.0 brings in new cyber-physical systems to deliver public services, to monitor government performance and to evaluate governance. Open innovation could generate new impulses for the design and realization of smart government. Open processes in a public process library would be a necessary foundation for smart record systems and smart notifications. A lot of possible interoperability problems could be resolved with open standards and open interfaces for smart government. Another huge potential lies in open source software repositories and collaborative software development platforms for smart government. And finally, all research results about smart government should be available via open access platforms and open research data platforms.

§ 6 – SMART GOVERNMENT IN PRACTICE: THE CITY OF ULM

In Germany, the City of Ulm is one of the contesters in the Federal Competition "City of the Future"[27,28]. The city has embraced digitalization as a challenge and an opportunity for the development. It has engaged in a participative, collaborative process of creating and implementing a vision for Ulm 2030. Its strategy shows clearly that elements of open and smart government as wells as open innovation go hand in hand when creating the smart city of the future.

As a starting point, the city created an online and offline brainstorming process that accumulated more than 400 suggestions on what should be thought of and done in the smart city Ulm. In six workshops, citizens and experts worked on six areas of city development:[29] (1) health and old age; (2) mobility, energy, and networking; (3) economy and employment; (4) education, science, and technology; (5) society, administration, and politics; (6) leisure, culture, and social engagement. The gathered impulses will influence the city's development in the coming years. In the first area, Ulm wants to develop tele-medical services. This means that physicians and medical personal diagnose patients remotely and offer assistance if the case allows it. This is especially suitable for patients that are unable to travel or require frequent check-ups. Also, remote assistance for rehabilitation enables patients to recover in their homes. Additionally, smart objects and homes with ambient assisted living can support elderly people and enable them to stay in their homes as long as possible. It is of course essential to create solutions that do not pose privacy risks.

When it comes to mobility, energy, and networking, Ulm wants to move beyond fossil fuels by developing shared and autonomous (electro) mobility with bikes and cars. This includes ticket-free public transport and citizen participation in the development of transportation solutions. Ulm already offers a testbed for autonomous driving, which should be expanded. Ulm also tests smart grids in a selected area of the city and researches new energy solution in a prototype house.

Regarding economy and employment, Ulm has strengthened its ties with local IT businesses by initializing a network that shares knowledge and experience: initiative.ulm.digital. This network now is a major driver behind the development of a LoRaWAN infrastructure to network smart objects. Additionally, Ulm is considering developing an incubator for industry 4.0 entrepreneurs. The city also launched a city laboratory ("Stadtlabor"[30]) which

[27] "City of the Future" (Zukunftsstadt) could be seen as another translation for the English Term "Smart City" into German.

[28] https://www.wettbewerb-zukunftsstadt.de.

[29] The results can be found: J. VON LUCKE, J, C. GEIGER, E. BREUING, *Wettbewerb Zukunftsstadt Ulm Vision 2030+ - Abschlussbericht der ersten Phase mit den Ergebnissen der Begleitforschung* (The Open Government Institute 2016).

[30] http://verschwoerhaus.de.

serves as experimental hackspace and meeting room to try out new ideas, foster innovation, and that provide a meeting point for the community.
In the field of education, Ulm wants to strengthen informatics as a subject in high schools and improve the development of digital literacy and media competency. Additionally, it wants to offer courses and workshops for different stakeholder groups. This is supplemented by an initiative to develop and use open educational resources.
In addition to its existing participation platforms and programs, Ulm wants to further develop its collaborative efforts in city planning and increase transparency, also by improving its open council information system by offering an API. Collaborative innovation will also play an important role in the area of culture, where citizens will participate in the planning of future events and programs. Ulm also wants to integrate emerging digital art into its portfolio and participate in cultural hackathons like Coding da Vinci. Augmented reality will provide visitors of museums and heritage sites with an even better experience.

SUMMARY AND CLOSING REMARKS

In the beginning of 2016, neither "intelligently networked government" nor "smart government" are established concepts in Europe. The definitions of these and related terms such as "smart agencies", "smart governance", "smart civil officers" and "smart citizens" are scarce. Visions for state and government on how to tap the potential of the Internet of Things and the Internet of Services are still missing. This paper offers a first contribution towards this goal by defining smart government, developing a vision and a scenario, and by providing a working example: The City of Ulm.
Additionally, federal, state, and local governments should consider these issues in a multilevel working group and perhaps in a smart government co-operation to work out their own definitions. The step towards a comprehensive intelligent networking can only succeed through the dialogue of politics and administration with science, business, and civil society. Definitively, all groups will be affected by the intelligent networking in government and administration. Moreover, they all want to contribute their ideas. This path should be embarked upon without delay, as the technological development progresses. The disruptive potential of smart objects and cyber-physical systems urgently creates a need for more intensive and substantial discussion and social discourse about smart government.
Under these conditions, it is a challenge for politics, administration, business and science to create, to build, to link, to control, to supervise, and to maintain trustworthy and reliable cyber-physical systems for the public sector. Based on the definitions, visions, and first scenarios, supporters and partners have to be found, goals to be agreed upon, work packages for a working plan to be

put together, resources to be provided, and prototypes to be developed. Human and financial resources should be provided appropriately where these are required for support and realization. A fundamental discussion "at zero cost" will not be sufficient because it will leave the achievement of meaningful progress to chance, making it dependent on the commitment of individuals and on the hidden agenda of the few sponsors, without taking the citizens and their interests seriously.

BIBLIOGRAPHY

ACATECH, *Cyber-Physical Systems: Driving force for innovation in mobility, health, energy and production* (Springer Verlag 2011).

ANTHOPOULOS G., L. REDDICK, *Smart City and Smart Government: Synonymous or Complementary?,* Companion of the 25th International World Wide Web Conference, (International World Wide Web Conferences Steering Committee 2016).

Bundesministerium für Bildung und Forschung, *Zukunftsbild „Industrie 4.0"* (2013). [German]

CHUI M., M. LÖFFLER, R. ROBERTS, "The Internet of Things" (*The McKinsey Quarterly*, vol. 47, n° 2/2010).

CLINTON B., *Back to Work: Why We Need Smart Government for a Strong Economy* (Knopf Doubleday Publishing Group 2011).

GARTNER INC., *Gartner Identifies the Top 10 Strategic Technology Trends for Smart Government* (2014).

GEISBERGER B., M. BROY, *AgendaCPS – Integrierte Forschungsagenda Cyber-Physical Systems* (acatech – Deutsche Akademie der Technikwissenschaften e.V. 2012). [German]

JIMÉNEZ-GÓMEZ C., F. FALCONE, A. SOLANAS, H. Puyosa, S. ZOUGHBI, F. GONZÁLEZ, "Smart Government: Opportunities and Challenges in Smart Cities Development – An IT & Public Organization Approach" (*Handbook of Research on Democratic Strategies and Citizen-Centered E-Government Services*, IGI Global 2015).

KEPPELER F., "Der smarte Beamte" (*Kommune 21 – E-Government, Internet und Informationstechnik*, vol. 16, n° 1/2016). [German]

NOVOSELIC S., *Smart Politics, Smart Government – Intelligent vernetztes Regierungs- und Verwaltungshandeln in Zeiten des Internets der Dinge und des Internets der Dienste* (ePubli GmbH 2016). [German]

RUBEL T., *Smart Government – Creating More Effective Information and Services* (International Data Corporation (IDC) 2012).

VON LUCKE J., GEIGER, C., BREUING E., *Wettbewerb Zukunftsstadt Ulm Vision 2030+ – Abschlussbericht der ersten Phase mit den Ergebnissen der Begleitforschung* (The Open Government Institute 2016). [German]

VON LUCKE J., *Open Government Collaboration – Offene Formen der Zusammenarbeit beim Regieren und Verwalten* (Zeppelin Universität 2012). [German]

VON LUCKE J., REINERMANN H., *Speyerer Definition von Electronic Government* (Forschungsinstitut für öffentliche Verwaltung 2000). [German]

VON LUCKE J., *Smart Government - The Potential of Intelligent Networking in Government and Public Administration*, CeDEM16 – Conference for E-Democracy and Open Government (IEEE Computer Society 2016).

VON LUCKE J., *Smart Government – Wie uns die intelligente Vernetzung zum Leitbild „Verwaltung 4.0" und einem smarten Regierungs- und Verwaltungshandeln führt* (Zeppelin Universität 2015). [German]