Co-Creating Smart Cities

The Case of the T-City initiative as best practice example for Responsible Research and Innovation in ICT

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Abstract: This case study describes the T-City initiative and uses it as a best practice example of how to include Responsible Research and Innovation into the transformation process connected with making cities 'smart'. The initiative aimed to showcase how modern information and communication technology can sustainably improve the quality of life and community living in the city of Friedrichshafen. Starting with a general description of the initiative the case study then focuses on the project area 'Health and Support' and examines two specific projects to illustrate best practice for Responsible Research and Innovation. It shows that the goals and perspectives of different stakeholders can be united and that win-win-situations can be generated. The T-City initiative was an inclusive approach in which societal actors worked together during innovation processes and became mutually responsive to each other to co-create the smart city of Friedrichshafen.

Keywords: Co-Creation, Smart City, Public Private Partnership, Stakeholder Engagement, Responsible Research and Innovation, Telehealth, Ageing Population, T-City, Health, ICT, Case Study, Best Practice

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Introduction

The ‘T-City Friedrichshafen’ initiative, initiated as a public-private-partnership (PPP) and a future lab by Deutsche Telekom AG and the city of Friedrichshafen, tried to show how modern information and communication technology (ICT) can sustainably improve the quality of life and community living and turn Friedrichshafen into a smart city.

With its holistic bottom-up approach, the initiative included a wide range of societal actors in the general development and implementation and in individual projects. The cooperation was operationalized through the creation of a central point of contact, the T-City representative office; the use of the T-City ambassadors who communicated ideas to citizens and visitors, and the implementation of the futurists program in which chosen residents of the city tested modern ICT in their homes and shared their experiences.

The widest range of stakeholders was reached through individual projects which were run hand in hand with the general activities of T-City. Different project areas were created of which ‘Health and Support’ was one of the most prominent. This case study focuses on the ‘Health and Support’ project area by presenting two of its projects in more detail - the PressureTel project and the Self-determined Living project.

The PressureTel project offered a home-based telemonitoring solution for patients suffering from high blood pressure with the goal to improve the therapy as well as to give patients a higher level of safety and quality of life. The Self-determined Living project aimed to enable users to live independently in their own homes and familiar environments for as long as possible, leading a safe and self-determined life even in older age. To be able to do this, users were provided with services which could be ordered through a touchscreen terminal installed in the homes.

With regard to the concept of Responsible Research and Innovation (RRI) this case study shows that the goals and perspectives of different stakeholders can be united and that win-win-situations can be generated. T-City was an inclusive approach in which societal actors worked together during the innovation process and became mutually responsive to each other despite initial reservations and doubts about the initiative.

Furthermore the case study demonstrates how companies – like Deutsche Telekom AG – can contribute to the grand challenges of society. It shows how modern ICT can handle important issues in health and demographics and help design innovations which meet societal needs.

The Vision - Making Friedrichshafen ‘smart’

The ‘T-City Friedrichshafen’ initiative (information about the initiative and pictures were taken from its website (Deutsche Telekom AG, n.d.b), the media kit (Deutsche Telekom AG, n.d.a) and the project overview (Deutsche Telekom AG, 2012) unless otherwise specified) was a partnership between the Deutsche Telekom AG – one of the biggest

telecommunication companies in Europe - and the city of Friedrichshafen, Germany. Friedrichshafen is a smaller city (58,000 inhabitants) in one of the most affluent areas of Europe (Baden-Württemberg). The initiative was undertaken between 2007 and 2012. With its vision to transform Friedrichshafen into a smart city, the initiative tried to show how modern information and communication technology (ICT) can sustainably improve the quality of life and community living in the city and connect its citizens and institutions in a better way.

T-City wanted to demonstrate the added value of innovative ICT to a range of areas, which are illustrated in the following figure:

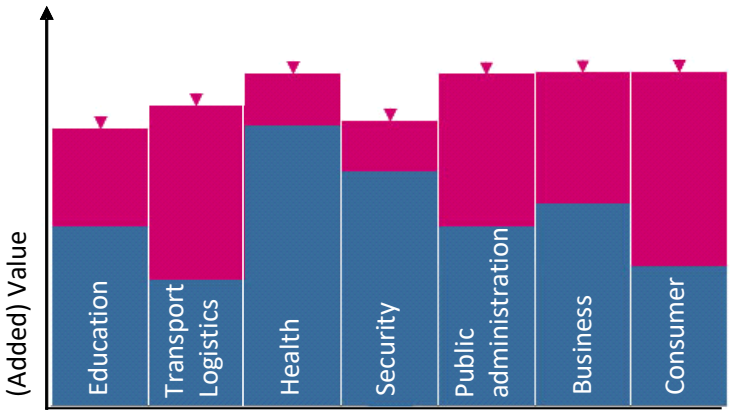

Figure 1: **Added Value (Deutsche Telekom AG, n.d.b - Author's illustration)**

Every city has its individual ICT profile. Taking this initial profile (blue bars) as a starting point the T-City initiative developed project ideas to advance the profile in each area (blue bars + magenta bars). To reach this target profile, the Deutsche Telekom AG set up a modern broadband infrastructure with fixed-line and mobile coverage virtually everywhere within Friedrichshafen.

More than 30 small and large-scale projects were implemented in T-City, taking central areas of urban life into consideration to improve the profile of Friedrichshafen. The projects spanned six different areas:

- Learning and Research
- Mobility and Transport
- Tourism and Culture
- Citizens, the City and the State
- Business and Work

- Health and Support

This case study concentrates on the area of 'Health and Support' to emphasize the role of ICT in health and ageing. Important projects in this area included testing telemedical systems designed to improve medical care or enhancing safety and the quality of life for elderly and chronically ill patients with diabetes or heart disease. Within this area two projects are of special interest (PressureTel – blood pressure telemonitoring - and Self-determined Living – home-based service terminal).

Projects of the T-City

Initiated as a future lab with the slogan 'T-City Friedrichshafen - Living the future' this partnership went far beyond the traditional understanding of a public-private-partnership (PPP). The entire urban society was invited to participate in the development of projects and innovations. Therefore the ideas for potential projects were generated within the city. For the first time citizens, companies, schools, organizations, research institutions and many more collaborated on innovative applications for everyday use in order to achieve sustainable improvements in the quality of life in Friedrichshafen.

T-City intended to make day-to-day life easier and to create tangible benefits in all areas of life for all stakeholders of the city; locals and tourists, young and old, teachers and students, council experts and entrepreneurs. The mayor of the city, Andreas Brand, emphasized the benefits for his city and the importance of including every resident:

> "T-City means that Friedrichshafen is now perceived as an innovative, future-friendly city even outside the state of Baden-Württemberg. But it is also equally important for me that virtually every resident benefits from one or even several T-City solutions" *(Deutsche Telekom AG, n.d.b).*

During the five years of partnership and cooperation more than 30 projects were realized. The following figure gives a short overview of projects in different areas.

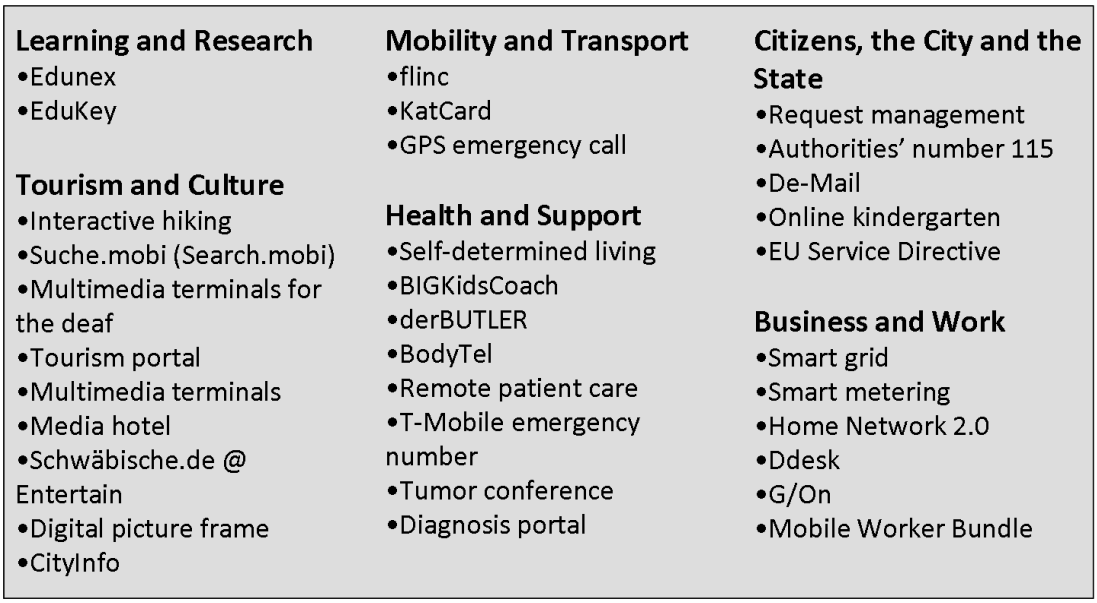

Figure 2: **Project Overview (Deutsche Telekom AG, 2012 - Author's illustration)**

Health and Support was one of the major project areas and had the largest number of projects (with the exception of tourism and culture) within T-City. Two of its many projects will be introduced here.

The **PressureTel project** was undertaken in collaboration with the Friedrichshafen Hospital, the city's adult education centre and a local health insurance provider, and led to an innovation with the following functions developed by T-City's partner BodyTel: blood pressure can be monitored and automatically recorded in an online-diary in a home-telemonitoring process performed by the patients themselves. Further information about medication, meals, activities or visits to the doctor can be added.

The data, which is transmitted automatically and secured in an online-diary (Secure Sockets Layer and in the case of T-City also Virtual Private Network connection (BodyTel, n.d., p. 8)), can be used by doctors to improve the treatment of the patient. The PressureTel system can also send alerts to a relative or the doctor if a predefined corridor is exceeded and therefore aid prompt action in the case of potential risks. The goal of the project was to make the life of patients with high blood pressure easier and safer and to make the processes in local surgeries and hospitals more efficient (e.g. multiple patients can be looked after simultaneously).

During development the following parameters were evaluated: acceptance by the patients and usability, changes in the quality of life of the patients and the optimization of the therapy. Furthermore improvement hints were gathered to further develop the system. In this context Michaela Klinger, Head of Marketing & Business Development at BodyTel noted:

> "[…] the improvements that were implemented while the project was […] running were good for everybody. For BodyTel to improve the product, for the clinic to monitor patients effectively and for the participants who felt they were in good hands, both with our products and the [… hospital of] Friedrichshafen" *(M. Klinger, personal communication, October 15, 2014).*

The **Self-determined Living project** provided services that allowed users to live independently in their own home and their familiar environment for as long as possible and lead a safe and self-determined life even in the case of illness or other impairments. The project was a cooperation between the Deutsche Telekom AG, the Fränkel AG and the residents of the 'innovation house' at 20, Saint-Diè-Straße in Friedrichshafen. Through a home-based touchscreen terminal, participants were able to use a range of services such as caretaker services, a pharmacy delivery service, delivery services for meals and groceries or information about public transport.

The residents were also able to maintain social contact with other users via videophone which was integrated in the terminal. The system can be customized and has a high potential for extension such as the integration of telemedical services or smart metering.

How T-City relates to RRI

The European Commission defines RRI as follows:

> "RRI is an inclusive approach to research and innovation (R&I), to ensure that societal actors work together during the whole research and innovation process. It aims to better align both the process and outcomes of R&I, with the values, needs and expectations of European society" *(European Commission, n.d.).*

This definition shows the strong focus on the premise of collaboration during research and innovation processes; which plays a crucial role in RRI in general (Bolz, 2017; Bolz & König, forthcoming; Stilgoe, Owen, & Macnaghten, 2013). The Commission names researchers, citizens, policy makers, businesses, third sector organisations etc. as societal actors that should work together (European Commission, n.d.)[1].

1 For the relevance of T-City to the five RRI Horizon 2020 action lines defined by the European Commission, see appendix.

Similarly, the T-City initiative aimed to include all important stakeholders in and around the city of Friedrichshafen. During the whole partnership there was a close collaboration between the main project partners (Deutsche Telekom AG and the city of Friedrichshafen), the four additional permanent partners (Alcatel-Lucent, Samsung Electronics, the German Association of Towns and Municipalities and the University of Bonn), the citizens and the partners in individual projects such as businesses, kindergartens, schools, hospitals etc.

All the above societal actors worked together during the innovation process to better align both the process and the outcomes of innovation, to create value and to meet the needs and expectations of the different stakeholders and society in general. Through this cooperation, different perspectives were taken into account while developing and implementing different projects and solutions. For example, the German Association of Towns and Municipalities ensured that the municipal perspective was taken into account. From the beginning the initiative was designed as a continuous process in which new solutions should be developed in cooperation with the whole city community. With its volume and duration the initiative was one of the largest corporate-citizenship projects worldwide (Hatzelhoffer, Humboldt, Lobeck, & Wiegandt, 2012).

This process dimension of RRI was supplemented by a product dimension. Von Schomberg emphasises this distinction in his view on RRI in which he defines RRI as:

> "[…] a transparent, interactive process by which societal actors and innovators become mutually responsive to each other with a view to the (ethical) acceptability, sustainability and societal desirability of the innovation process and its marketable products (in order to allow a proper embedding of scientific and technological advances in our society)" *(Schomberg, 2013).*

Furthermore he suggests to evaluate and design products with a view to the following three normative anchor points: high level of protection to the environment and human health, sustainability, and societal desirability (Schomberg, 2013).

The two products presented in the sections above – the PressureTel system and the Self-determined Living terminal – both exemplify von Schomberg's view on RRI. Both products were developed and implemented to improve the quality of life of the users and to help them to organize their everyday lives in more effective ways.

Stakeholder engagement

Cooperation between different stakeholders played an important role throughout the life time of the initiative.

The representative office, the ambassadors and the futurists

To give the citizens of Friedrichshafen or anyone who was interested in T-City a central point of contact, the representative office was created. It was the hub for the joint future lab. The office was also responsible for general communication and for raising awareness of the objectives, the content of the initiative and the individual projects. Furthermore it offered walk-in appointments for senior citizens who were concerned about modern ICT, and was the central point of contact for residents having a project idea. As already mentioned, the project ideas were developed within the city. If a project proposal met the T-City project criteria, they were reviewed for feasibility and implemented after selection by the partners.

To reach the whole community the representative office also used T-City ambassadors to ensure that residents, businesses or visitors were provided with comprehensive information. Under the slogan 'Häfler für Häfler' ("Häfler" is a nickname for the citizens of Friedrichshafen) a total of 30 residents of Friedrichshafen and the surrounding area were selected as T-City ambassadors. They represented different age groups and professions and were regularly trained on all projects and fundamental technologies to be able to explain the underlying technologies and make people aware of the practical application options. They also communicated T-City ideas to citizens and visitors and shared their enthusiasm for the project. Furthermore it was possible to book the ambassadors free of charge for individual informational events.

Different stakeholders as part of the development process

All partners including the patients who were involved in the **PressureTel project** tested the system over one year and helped to improve the product. In this context the ongoing collaboration between the innovating company (BodyTel) and the hospital of Friedrichshafen, where the monitoring platform was used, was important. Michaela Klinger stated in this context:

> "[…] I had a strong connection to the [… hospital of] Friedrichshafen who used our monitoring platform to look at the [… patients] blood pressure values. […] While using these tools the nurse in charge provided me with a lot of usability improvement hints. I collected them and handed them over to development that programmed and implemented them as soon as possible. Seeing the tools become more usable and smarter encouraged doctors and nurses to monitor patients

more closely and patients did benefit from that closer monitoring" *(M. Klinger, personal communication, October 15, 2014).*

The hospital of Friedrichshafen was responsible for the medical support of the patients and helped them adjust their high blood pressure treatment. In the case of technical problems BodyTel helped the patients by phone or with step-by-step instructions which were received by mail. As a tool for regular feedback with the patients a standardized questionnaire was implemented which was answered in an interview. In addition the SF-12 questionnaire – which is an international standardized patient-reported survey for patient health - was used to track the development of quality of life (BodyTel, n.d.).

In the **Self-determined Living** project different stakeholders were also engaged in the development process. They helped to test the system regarding functionality; especially addressing acceptance and usability issues, benefits, order and payment methods and cooperation with service providers, and thus helped to further develop the service (Hatzelhoffer et al., 2012).

Achieved impacts

The evaluation of the **PressureTel project** showed that 22 of 27 patients perceived the telemonitoring process as positive which reflects a high acceptance rate of 81.5%. The usability of the system was evaluated with nearly 100% responding positively, which is very important in a system for daily use. Of direct impact was the fact that the medication was adapted in 50% of the cases, and in one case it was possible to stop the medication completely (BodyTel, n.d.).

A possible explanation for the adaption of medication can be seen in the assumption that the blood pressure values measured in a familiar environment are more representative than when measured in local surgeries and hospitals. Furthermore the general quality of life increased and the number of stays in the hospital caused by high blood pressure decreased (BodyTel, n.d.). This positive impact and success regarding the treatment of high blood pressure on behalf of the patients could be one reason for the high acceptance rate. This is also important from an economic point of view. Overall economic benefits can be assumed regarding the better and more efficient treatment of high blood pressure; for example lower costs for doctors and hospitals, as well as medication.

Regarding the societal challenges of an aging society, the partners in the **Self-determined Living project** developed a system which showed that it can help make life easier in older age. For the residents, the services want to provide more independence and a more self-determined life as well as a higher level of security and quality of life and new opportunities for social interaction. In this context Gunde Dageförde, resident of one of the 19 apartments of the 'innovation house', stated in an interview with the T-City

Magazin (2011) that she tested the service terminal and was made familiar with the technology to be able to use it and be prepared when she needs it. Another resident said:

> "The terminal is really easy to use. […] Just a few taps and the services are tailored to my needs. This is much clearer to me than the internet" *(Deutsche Telekom AG, n.d.b – Author's translation).*

According to a statement of T-City the project also benefited other stakeholders. The Fränkel AG, as a real estate company, was able to improve the quality of their apartments resulting in higher satisfaction of the residents and lower fluctuation; for the individual service providers the terminal was a new chance to increase customer loyalty and to explore new sales channels, and for the Deutsche Telekom AG it offered a new business model in the real estate business. From an economic point of view, solutions which help people to live independently for a longer time are likely to ensure savings in care and nursing services.

Lessons learned

In general the initiative was seen as positive by those who participated in it. For example Jan von der Decken, whose family participated, said:

> "As a futurist using the new technologies, my life has certainly improved but not fundamentally changed. However, I believe that the city of Friedrichshafen and its residents as well as its industries have greatly benefited from the T-City project, directly and indirectly, and that Friedrichshafen will continue to benefit from it in the future" *(Deutsche Telekom AG, n.d.b).*

But there have also been sceptical and critical views on T-City. Reservations and doubts have been expressed about active participation in the initiative. Hatzelhoffer et al. (2012, pp. 193–194) attribute this to general fears and partial distrust towards new technologies. They especially mention concerns regarding radiation of wireless applications, data security and data loss.

In a survey performed by Hatzelhoffer et al. (2012, p. 197) in 2012, 54% of 1001 survey participants stated that they are concerned that the protection of their personal data is not taken into account sufficiently while new ICTs are implemented. It can be assumed that this is particularly true in the case of processing health data such as in the PressureTel project. But as already mentioned the positive impacts of the PressureTel project on behalf of the patients could be one reason for the high acceptance rate. It has also been found that a major part of the community of Friedrichshafen did not see the initiative as a project of cooperation nor of participation; instead they were concerned about the strong influence of Deutsche Telekom AG regarding the design of T-City, about the

opportunities to participate, and the strong focus on technology rather than on the community and the people living in Friedrichshafen (Hatzelhoffer et al., 2012).

Overall, the T-City initiative was a project that showed that the various goals and perspectives of different stakeholders can be united and that win-win-situations can be generated. It also showed that a high level of interaction is important for the successful implementation of such a visionary approach, which aims to contribute to solving social challenges like the ageing society. The case of T-City also shows that it is important to address fears and worries and a generous portion of distrust towards new technologies. Regarding this aspect there should have been more activities offered to address such concerns, with a stronger focus on the community and the people living in Friedrichshafen.

Taking a look at the definitions of RRI by the European Commission and von Schomberg this case study emphasised the strong connection of the T-City Friedrichshafen initiative to this concept. T-City was an inclusive approach in which societal actors worked together during the innovation process and became mutually responsive to each other. The interactive process of development and implementation induced the alignment of the process and the results to benefit a wide range of stakeholders. Particularly the presented projects – PressureTel and Self-determined Living – showed that such approaches and solutions are feasible.

The case study also demonstrates how companies like Deutsche Telekom AG can contribute to the grand challenges of society in the future. It shows how modern ICT can handle important issues in health and demographic transition. Different stakeholders can be integrated in innovation processes as responsive partners for companies to help design innovations which meet societal needs and to contribute to the acceptability of such innovations and technologies within society. Furthermore the projects were performed with a focus on marketable products, thus underlining the compatibility of economic goals and societal needs.

Because of its success, the partnership has been continued until 2015 with a focus on energy, healthcare and mobility to further develop existing projects (e.g. smart metering, tumour conference) and implement new ones (Deutsche Telekom AG, 2013).

References

BodyTel. (n.d.). *Abschlussbericht Telemonitoring bei Bluthochdruck: T-City Projekt*. V9.

Bolz, K. (2017). Who should be the principal of innovation? *Journal of Responsible Innovation*, *4*(1), 78–81. https://doi.org/10.1080/23299460.2017.1320645

Bolz, K., & König, H. (forthcoming). Can responsible innovation be a moderator of entrepreneurship? Learnings from the debate on advanced biotechnology. *International Journal of Business and Globalisation*.

Deutsche Telekom AG. (n.d.a). T-City Media Kit. Retrieved from http://www.telekom.com/medien/medienmappen/t-city/812

Deutsche Telekom AG. (n.d.b). Website T-City Friedrichshafen. Retrieved from www.t-city.com

Deutsche Telekom AG. (2012). *Overview of the T-City project*. Corporate presentation.

Deutsche Telekom AG. (2013). *T-City: Overview 2012 - 2013*. Corporate presentation.

European Commission. (n.d.). Science with and for Society. Retrieved from http://ec.europa.eu/programmes/horizon2020/en/h2020-section/science-and-society

Hatzelhoffer, L., Humboldt, K., Lobeck, M., & Wiegandt, C.-C. (2012). *Smart City konkret: Eine Zukunftswerkstatt in Deutschland zwischen Idee und Praxis ; Evaluation der T-City Friedrichshafen*. Berlin: Jovis.

Klinger, M. (2014, October 15). Questionnaire on activities of BodyTel during the T-City initiative.

Schomberg, R. von. (2013). A Vision of Responsible Research and Innovation. In R. Owen, J. R. Bessant, & M. Heintz (Eds.), *Responsible Innovation. Managing the responsible emergence of science and innovation in society* (pp. 51–74). Chichester: Wiley.

Stilgoe, J., Owen, R., & Macnaghten, P. (2013). Developing a framework for responsible innovation. *Research Policy*, *42*(9), 1568–1580. https://doi.org/10.1016/j.respol.2013.05.008

T-City Magazin. (2011). *T-City Magazin 34: Self-determined Living*. Retrieved from http://www.youtube.com/watch?v=i0SKFJyDpWU

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Appendix - Relevance to the five RRI Horizon 2020 action lines

The European Commission defined five RRI action lines to put the concept of RRI into practice (European Commission, n.d.). The connection of the T-City initiative to these action lines can be illustrated as followed:

1. engage society more broadly in its research and innovation activities,

→ strong: both projects involved end users in the design of new systems throughout; in addition the whole initiative was tailored towards citizen input.

2. increase access to scientific results

→ medium: the ambassadors of T-City helped provide access to scientific results in terms of project results from the initiative.

3. ensure gender equality, in both the research process and research content,

→ no special focus recorded.

4. take into account the ethical dimension

→ medium: feedback from society on the ethical dimension (e.g. privacy) was obtained during the innovation process.

5. promote formal and informal science education

→ medium: citizens not normally very scientifically literate were educated to use medical equipment and computers to access new services.