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UNVEILING INNOVATION: USING INNOVATION BIOGRAPHIES IN EVALUATION PRACTICE - A REFLECTION

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ABSTRACT

A wide range of RTI funding measures are implemented at regional level in European Structural and Investment Funds programmes. During the 2014-2020 funding period, the Berlin European Regional Development Fund (ERDF) programme included direct funding for R&D projects by companies conducted in collaboration with research institutions, support for innovative start-ups through venture capital funds as well as the establishment of application labs and validation centres at research institutes and universities. A multi-year, accompanying evaluation (2016-2024) was conducted on behalf of the Berlin Managing Authority for the ERDF programme.

In this evaluation, the use of innovation biographies represented a novel approach. This new research approach allowed the reproduction and analysis of the entire process of knowledge generation and application in specific innovation processes of companies, universities, and non-university research institutions. A total of 23 innovation biographies were created and analysed in a joint manner in accordance with the impact pathways of the theory of change.

From the perspective of a policy maker, the results of this analysis demonstrate the interplay between various funding measures and the influence of external factors on innovation processes. The innovation biographies present an authentic portrayal of the extended periods of time required for the outcomes of funding to be realised.

The contribution presents insights gained through the utilisation of this qualitative approach in evaluation with illustrative examples. This method is particularly suited to map the complexity of innovation processes at the micro level. Consequently, the paper contributes to the advancement of R&I policy evaluation frameworks and methods.

Keywords: innovation biographies, ERDF, qualitative evaluation method, innovation process, accompanying evaluation

ZUSAMMENFASSUNG:

In Programmen der Europäischen Strukturfonds werden vielfältige FTI-Fördermaßnahmen umgesetzt. Das Berliner EFRE-Programm enthielt in der Förderperiode 2014-2020 u.a. die direkte Förderung von FuE-Vorhaben von Unternehmen im Verbund mit Forschungseinrichtungen, die Unterstützung von innovativen Gründungen durch Risikokapitalfonds und den Aufbau von Applikationslaboren und Anwendungszentren an Forschungseinrichtungen und Hochschulen. Für das EFRE-Programm wurde (2016-2024) eine mehrjährige begleitende Evaluierung im Auftrag der Berliner EFRE-Verwaltungsbehörde durchgeführt.

Zur Evaluierung der Prioritätsachse 1 „Innovation“ des EFRE-Programms in Berlin wurden erstmalig Innovationsbiografien als zentrale Evaluationsmethode angewendet, mit dem der gesamte Prozess der Wissensgenerierung in konkreten Innovationsverläufen der untersuchten Unternehmen, Hochschulen und außeruniversitären Forschungseinrichtungen nachgebildet werden konnte. Erstellt wurden insgesamt 23 Innovationsbiografien, die für die Evaluierung entlang des Wirkungsmodells ausgewertet wurden.

Für die Stakeholder aus Politik und Verwaltung wird anhand der Innovationsbiografien insbesondere das Zusammenspiel verschiedener Fördermaßnahmen und der Einfluss externer Faktoren auf die Innovationsprozesse deutlich. Die Innovationsbiografien zeigen den Zeitaufwand, der bis zur Realisierung von Forschungsergebnissen benötigt wird.

Der Beitrag stellt die Erfahrungen mit dieser qualitativ ausgerichteten Methode anhand von Beispielen vor. Mit dieser Methode lässt sich insbesondere die Komplexität von Innovationsprozessen auf der Mikroebene abbilden. Dadurch wird ein Beitrag zur Weiterentwicklung der Evaluationsmethodik geleistet.

Schlagworte: Innovationsbiografien, EFRE, qualitative Evaluationsmethode, Innovationsprozess, begleitende Evaluierung

1. INTRODUCTION

A wide range of RTI funding measures are implemented at regional level in European Structural and Investment Funds programmes. For the 2014-2020 funding period, Berlin's ERDF (European Regional Development Fund) programme included among other actions direct funding for R&D projects by companies conducted in collaboration with research institutes, support for innovative start-ups through venture capital funds and the establishment of application labs and validation centres at research institutions and universities. The specific objective of this programme is to intensify and expand the innovation activities of the business sector. The entire innovation process is to be strengthened.

A total of almost 600 million euros in eligible expenditure was available for this purpose, this is 45% of ERDF funding for the entire funding period in Berlin, thereby making this axis the largest component of the Berlin programme. The actions under this priority axis covered all phases of the innovation process (applied industrial research, experimental development and production set-up / market launch) as well as finding co-operation partners through network funding (in the clusters of the Regional Innovation Strategy and within the cultural industries).

A multi-year, accompanying evaluation for the ERDF programme was conducted on behalf of the Berlin Managing Authority in the Senate Department for Economic Affairs, Energy and Public Enterprises. In accordance with Article 54 of Regulation (EU) No. 1303/2013 and Berlin's evaluation plan, the effectiveness of the funding, its efficiency and its impact of each priority axis were assessed. The accompanying evaluation of the 'Innovation' priority axis started in June 2016. An interim report was produced in 2018 (IfS 2018). The final report was published in 2023 (IfS 2022).

2. METHODOLOGY

The study design for the evaluation of the priority axis was programme theory based (Funnel and Rogers 2011, Rogers 2014). The aim of the study was to reconstruct impact pathways and show how and under what circumstances

the interventions work or do not work. In accordance with the evaluation plan, the study design was based on the understanding of the theory of change of ERDF funding as described in the 'Guidance Document on Monitoring and Evaluation', according to which external factors in addition to the intervention also have an impact on the results (European Commission 2014: 6). In this priority axis, the interplay between the various measures and external factors was examined during the programme period. The design thus corresponds to the complex objective of the priority axis ('strengthening the entire innovation process') and the diverse measures.

As a novelty in evaluations, innovation biographies (adapted from Butzin et al. 2012) were chosen as the central method. The final report is largely based on the cross-evaluation of the innovation biographies. It was accompanied by an analysis of monitoring data provided by the programme owners.

Innovation biographies as such are not new, but their use in evaluation is. The main methodological source was the work of the Institute for Labour and Technology Gelsenkirchen (Helmstädter / Widmaier 2001), which compiled the first innovation biographies around 2000. As part of the European project EURODITE - Regional trajectories to the knowledge economy[1] (6th EU Framework Programme, 2005-2010), 60 innovation processes were analysed. In addition, there were further applications at national level, e.g. in the construction industry, nanotechnologies and renewable energies in Germany.

Innovation biographies are a research approach that can be used to empirically capture knowledge dynamics in innovation processes from a spatial and sectoral perspective. Innovation biographies make it possible to model the process of knowledge generation in concrete innovation processes, from the initial idea to the concrete form of a new product or service, production set-up and market launch. This approach considers changes in the theoretical and empirical debate on innovation (Rammert 2000, Crevoisier/ Jeannerat 2009). At the same time, an exploratory approach enables the mapping of the influence of external factors in the same manner as that of the various support measures, thus facilitating a more comprehensive understanding of the mode of action.

The evaluation design, in the form of such innovation biographies, allows for a thorough examination of the individual case. This is particularly evident when considering the specifics of the project, historical coincidences, and external

1 https://www.uni-marburg.de/de/fb19/forschung/forschungsprojekte/geographie-der-dienstleistungen-kommunikation-und-innovation/docs/eurodite_abstract_engl_long.pdf

influences. The development history of the projects in their interaction with the environment in which they are operating can thus be analysed.

A 'panel' of 23 innovation projects was utilized to map the respective innovation development. The cases were selected from different measures (R&D projects of companies, venture capital investments and application labs) in three consecutive funding years (2015-2017). Based on monitoring data, the selection of cases was informed by an appropriate mix of sectors, fields of technology and company sizes, as well as types of organisations (enterprises, universities, non-university research institutions). Investment stages (seed, startup, growth) as well as cooperation patterns (individual or collaborative project) have also been considered. This resulted in an equal representation of the project types and corresponded to the approval patterns of the individual actions.

The accompanying evaluation of the ERDF allowed for a long-term study design over the entire funding period. The observation period ran from July 2016 to May 2021. Each selected project was interviewed once a year. The observation period for each individual case is at least four and up to six years in duration. In some cases, the history of each innovation is documented over a period of up to 10 years. This allowed a long-term perspective beyond the (limited) duration of the funded project. In addition to the annual interviews with the management of the company or project leaders, exploratory interviews were conducted with key cooperation partners and investors.

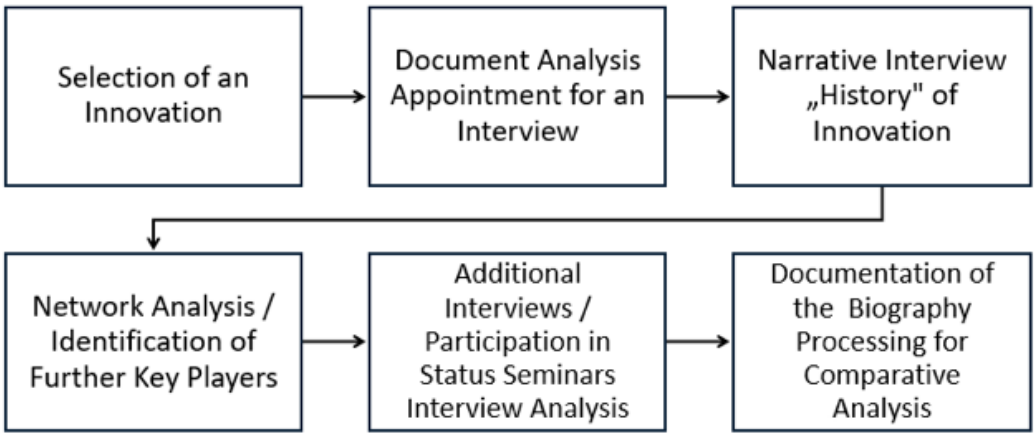

Figure 1: Approach in the Innovation Biographies
Source: Own elaboration based on IfS 2022

An innovation biography was created for each case study, in which all significant aspects and factors influencing the development of the innovation were presented and integrated into their context. This included an explanation of the impetus that led to the initial idea, the obstacles and difficulties encountered, a trajectory of knowledge development and the associated

network of stakeholders. Furthermore, the chronological sequence of predecessor and successor projects was also considered. The innovation biographies were updated annually. Finally, the analysis of the innovation biographies was conducted in a joint manner, in accordance with the impact pathways of the theory of change.

The basis for the synthesis was laid by the interviews in the form of transcripts or notes plus internet research and documents. The company or research organisation received its own updated innovation biography for information purposes. In a first section, it contains a description of the innovation that largely abstracts from technical details. The core is the understanding of its Unique Selling Proposition, which problem it solves or need it fulfils, its price model, target customers, etc. The second section describes the chronological processes and events that influence or relate to the innovation. Additionally, these have been visualised in a detailed timeline. The documents of the innovation biographies comprised up to 30 pages.

In an additional working paper per case, the evaluation team reflected on the case based on the impact pathways. This internal working paper documented the activities of the evaluation team, recorded additional information as well as special features and open questions. At the same time, the contents of the innovation biographies were prepared for the cross-evaluation (e.g. success factors and obstacles) of the cases. The content of the interviews was immediately processed in the form of these two documents (innovation biography and working paper). Both together provided the basis for the cross-evaluation and synthesis. In the synthesis, the findings from the individual innovation biographies were collated using selected questions and parameters based on the impact pathways and assumptions.

3. EXAMPLES OF INNOVATION BIOGRAPHIES

Two examples from different funding measures are presented here to illustrate the method. It is not possible within the scope of this article to present all the details of each innovation biography, but these case studies show that the funded project is part of a long-term chain of activities and projects. It is preceded by other funded or non-funded projects, or is followed by other projects and other activities, each with their own objectives. A variety of factors influence the success or failure of innovations.

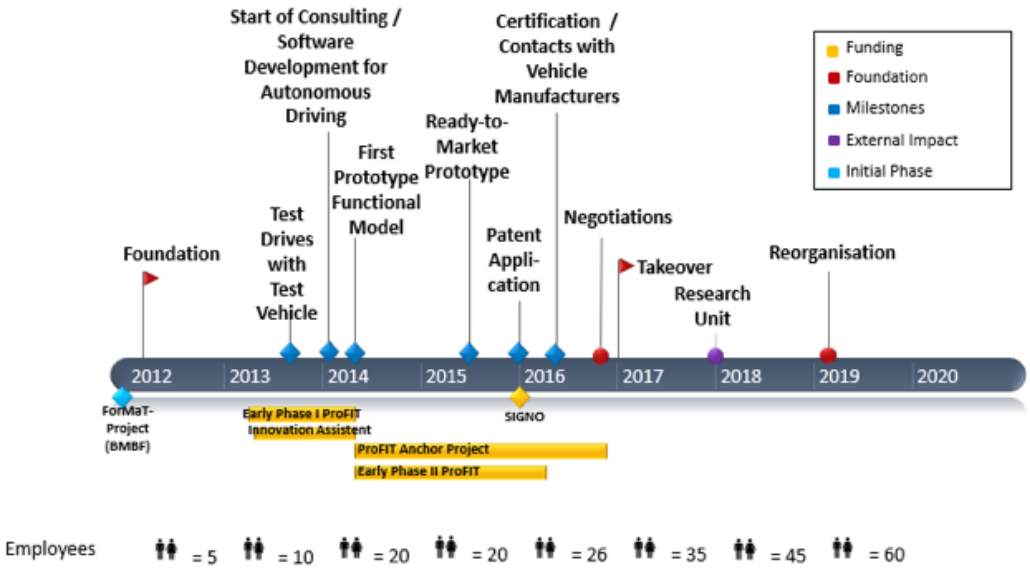

Figure 2: Example 1 - Reversing Assistance System for Refuse Collection Vehicles
Source: IfS 2022

Refuse collection vehicles have frequent accidents when reversing. The idea of this R&D project was to develop a camera-based system with image recognition instead of sensors to avoid collisions.

The timeline clearly shows that various support measures are interlinked here over time. The initial idea was developed in a ForMat project[2] funded by the Federal Ministry of Education and Research (BMBF). Here, engineers and business economists at the TU Berlin developed use cases for image recognition components that emerged from research work on autonomous driving. The company was a university spin-off. The Berlin ProFIT funding in the early phase made it possible to establish and develop the company's organisational structures. An innovation assistant was hired to support innovation management. The only measure that was financed by the ERDF is the ProFIT anchor R&D project. In a later phase, the patent application was subsidised at federal level (SIGNO Programme).

This example also illustrates the influence of the regulatory framework. During the development of the product, a ban on reversing for refuse collection vehicles was discussed. This uncertainty about the chances of use led to months of delays. The certification requirements regarding the robustness

2 The ForMaT Programme (Forschung für den Markt im Team) placed a particular focus on designing research results in such a way that they have practical applications on the market and can be successfully placed there. The programme ran from 2005 to 2017.

of the product for heavy goods vehicles also made the camera system considerably more expensive.

Alongside this product development, the company developed software related to image recognition for autonomous driving. At the end of the project a demonstrator of the reversing assistance system was available. But the project ended early due to a company takeover. There was no market launch of the assistance system, but R&D jobs in new enterprise were retained in Berlin. Regarding the achievement of the objectives of the ERDF programme it can be said in this case, that there is no new product in the market, but local R&D capacities have been strengthened.

This innovation biography contributed to the following selected findings:

- The subsidised project is only a small part of a longer innovation process (32 months preliminary phase from the first innovation idea and 33 months project duration).
- Product development would not have been able to take place without the simultaneous funding of the company set-up.
- Innovation processes can be stopped by taking over the companies, but the acquired knowledge lives on and is utilised elsewhere.
- What matters is not the specific new product on the market, but that knowledge-intensive R&D jobs are retained in the region.
- Pending regulatory procedures and high regulatory requirements slow down and jeopardise product development and make the product more expensive.

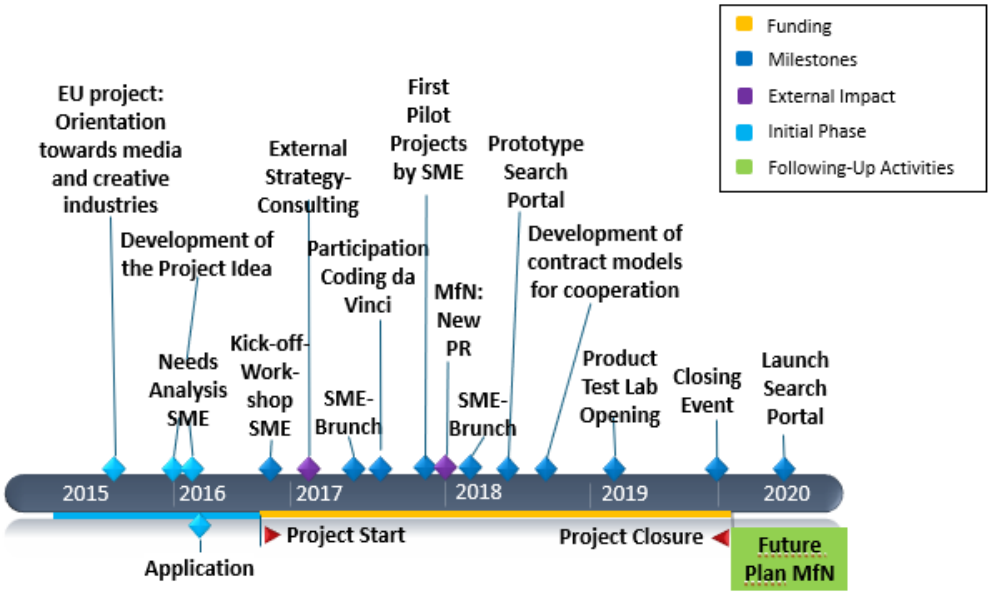

Figure 3: Example 2 - Mediasphere for Nature at Natural History Museum
Source: IfS 2022

The Mediasphere for Nature is a multimedia application laboratory at the Natural History Museum in Berlin. It is a research museum, so it is part of the Leibniz Institute for Evolution and Biodiversity Research. The objective was to make the rich collections (over 30 million collection items) available to users (especially SMEs) from the cultural and creative industries, whereby neither a strategy nor contacts of the museum to this sector existed beforehand. The idea of opening the collections to the creative industries came about as part of an earlier EU project[3].

Numerous networking activities were carried out, contacts have been established with interested SMEs and collaborations (28 cooperation agreements) have been realised. Demand among SMEs was high and has risen steadily. The museum developed internal structures and expertise for cooperation with such companies (e.g. granting of rights, contract models, work processes). A wide range of applications (VR, AR, videos, games, educational materials, touchable exhibition objects for the blind) were developed by the SMEs. They used animal voice recordings, documentation of research trips or expeditions, plant textures, digital animal models, specific research results like: "How does a frog perceive its surroundings?"

3 The Europeana Creative project (2013-2015) enabled and promoted greater re-use of cultural heritage resources by creative industries. The Museum was involved in a pilot project in the field of natural history. See https://pro.europeana.eu/project/europeana-creative-project

(for an interactive VR experience[4]). It was also possible to test products, apps or games with visitors to the museum.

After the end of the funded project, cooperations are being continued in new projects with SMEs. As part of the Future Plan for the Museum, considerable funds have been made available for the further digitisation of the collections. The Mediasphere will be a sub-project for improved access, innovation and networking. The media repository and research portal, the experimental field and the SME network will be continued within this framework.

This innovation biography contributed to the following learnings:

- For a research institute to cooperate successfully with SMEs, certain requirements must be met. Internal organisational structures, work processes and knowledge of the needs and requirements of SMEs were lacking. A transfer strategy was necessary to reach the target group.
- In communication between scientists and SMEs, there are often major differences in expectations and time management that need to be overcome.
- Delays in implementation resulted primarily from difficulties in precisely defining the required task profiles for newly created positions and finding the appropriate personnel.
- The lessons learnt from the project are valuable for other research museums at an international level.

Both innovation biographies illustrate the range of possible findings, only a fraction of which could be presented here. Finally, a total of 23 innovation biographies were available for the summarised analysis and synthesis. The table shows the parameters conceptualising the results in the two reports. The focus shifts from the first phases of the innovation processes in the interim report to the results and impacts in the final report.

Table 1: Main parameters of the synthesis

	Parameters conceptualising the synthesis results
Interim Report 2018 (IfS 2018)	▪ Role of funding in the innovation process: expansion of R&D capacities in the company, effects in addition to cost reduction and risk mitigation ▪ Expansion of R&D capacities in application laboratories ▪ Access to financing for innovative start-ups ▪ Innovative and creative impulses through co-operation ▪ Development of the initial innovation idea: problem seekers, problem solvers and customer understanders ▪ Other factors influencing innovation: economic situation, choice of location in innovative hotspots, shortage of skilled labour, technical and commercial expertise in the founders' team, legal framework conditions ▪ Interplay of funding measures in the innovation process ▪ Experiences with the application process and implementation of funding
Final Report 2022 (IfS 2022)	▪ Expansion of R&D capacities in companies: Implementation of R&D projects and direct job effects, development of R&D intensity ▪ Market launch of new products and services, status and duration of the development process from idea to market launch ▪ Effects on R&D behaviour, innovative capacity and technological skills ▪ Effects on cooperation behaviour in R&D and in other networks and clusters ▪ Strengthening the transfer activities of research institutions and universities: utilisation of funded infrastructures, strengthening of application orientation, cooperation with SMEs ▪ Growth of companies, creation and safeguarding of jobs, stability and future of companies ▪ Effects of the COVID-19 pandemic

4. EXPERIENCE, BENEFITS AND APPLICABILITY AS AN EVALUATION METHOD

The consolidation and synthesis of the innovation biographies for the overall evaluation reports was challenging and time-consuming because a lot of material (innovation biography, working document, timeline) was available.

The main risks in applying this method were whether the companies would participate for so long and allow these insights into innovation activities. Consistent cooperation and trust were built up during the interviews. This worked well in Berlin but required staff continuity in the evaluation team throughout the entire observation process.

The advantages of the method lie in the longer-term perspective, which extends far beyond the funding period and after project end. The explorative approach can discover impact factors that were not anticipated by the evaluation team based on field knowledge and literature (e.g. impact on innovation management). The process view shows all interactions and loops during the innovation process. It allows for a better understanding of mechanisms and time sequences. The method made it possible to map the influence of both, external factors and ERDF funding alike. In contrast to conventional case studies, the focus of innovation biographies is on the innovation, while other case studies often only focus on the funded project and remain within the logic of a single programme.

The method is based on storytelling.[5] The evaluation team comes as listeners. Storytelling is a natural way to share information and experience. Lively stories beyond bare facts and figures have been received. The depth of stories allows to show complexity in the innovation process as well as in its context. It is not always possible to assume that practitioners from the administration (as clients of the evaluation) or political actors and other stakeholders (as addressees of the evaluation results) have knowledge of operational practice in companies or research institutions. Here, the method proved to be particularly fruitful in achieving a greater and more realistic common understanding of how the funding works for the beneficiaries.

5 Several approaches use storytelling to evaluate impact, especially the Most Significant Change, see Snow et al. (2021).

It was also possible to show which time periods are realistically required until an outcome (e.g. the utilisation of R&D results on the market, job creation) becomes apparent. A lot can happen during this period that influences the effects of the funding. For example, the innovation biographies included reorganisations and strategic takeovers in companies, insolvencies, staff changes and far-reaching financial and investment decisions. The organisations were affected differently by the impact of the coronavirus crisis and their handling of the pandemic restrictions varied considerably. The method underscores the importance of evaluation principles to listen carefully and consider context.[6]

In addition, the method proved to be a very powerful tool for communicating and reflecting on the evaluation results. Compared to other evaluations without the use of innovation biographies, it led to particularly lively discussions with stakeholders about the cases, the evaluation results based on them, the support measures as such, and the conclusions. Here, too, a story is told, which makes the complexity of innovations comprehensible for the policymaker (away from the abstract 'number' towards a real understanding of an innovation process). In addition to the linear time axis, the non-linear influencing factors are also clarified. From this and from the large number of innovation biographies, the transferability of the results arises, which in turn leads to further development of the funding, as innovation processes are better understood.

The accompanying evaluation setting in Berlin was certainly unique because most common evaluation studies cover a shorter time span and therefore have fewer observation points. The timing of the interviews is variable but should cover 3-4 points in time (at least project start, project end and later with a greater interval). It is also possible to apply the method in full retrospect. The disadvantage of the method is the relatively high cost for an enormous depth in a few cases. The costs can be influenced by the frequency of the interviews.

Innovation biographies can also contain a spatial component, which regions contribute to the generation and dissemination of knowledge. This was not so interesting in a city like Berlin but could play a greater role in larger regions.

The method is thematically open and broadly applicable. This evaluation study focussed on innovation ideas from many fields and sectors as well as key business ideas from start-ups. However, the method has also been

6 This refers especially to Standard G2 Accuracy: Context analysis: "The context of the object of Evaluation should be analyzed comprehensively and in sufficient detail and taken into account in the interpretation of results." DeGEval (2017), p. 44.

applied to the core idea of application labs at research institutions. Innovation biographies of social innovations are also conceivable. Therefore, innovation biographies could be a good qualitative supplement in larger, accompanying evaluations.

CONCLUSIONS

The contribution presents experiences with innovation biographies as a qualitative evaluation method. It clearly shows the interplay of different funding measures (including ERDF and other national and European funds) in the innovation process and the influence of political and regulatory frameworks and other external factors. The narrative style used in the innovation biography makes the impact mechanism of the funding visible, thereby facilitating the communication of evaluation results to stakeholders and a wider audience. The innovation biographies also provide an authentic account of the extended time periods required to realise the outcomes of the funding. In certain cases, this spans across several funding periods.

The benefits of this approach and its applicability to the evaluation of RTI measures have been discussed. The risks involved in implementing and analysing innovation biographies (especially the creation of trust) proved to be manageable. In future, the analysis of the extensive material generated by a larger number of innovation biographies could be facilitated by using AI. As an evaluation method, innovation biographies can be used to capture the complexity of innovation and transformation processes at the micro level. Consequently, the method contributes to the advancement of R&I policy evaluation frameworks and methods.

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