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Authors:

Sophie Hieke, Tamara Bucher, Bent E. Mikkelsen, Paul Finglas, Jos van den Puttelaar

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Karin Zimmermann
Project Coordinator



Prof Pieter van 't Veer
Scientific Coordinator

Summary

As part of phase 2, this work package has dealt with identifying and studying laboratories and other research facilities across Europe, their structures, purposes and technical specificities, to better understand their needs and wants, but also what they might have to offer to a research infrastructure (RI) as the one planned in RICHFIELDS. Within this framework, case studies have been developed detailing three example laboratories: the Fake Food Buffet at ETH Zurich, the FoodScape Lab at Aalborg University and the Restaurant of the Future at Wageningen University. Additionally, a mapping exercise was carried out to identify further laboratories and research facilities across the EU dealing with research into consumers, food and health behaviours. Of these, two were selected for in-depth interviews (Nestlé Research Centre, Lausanne, and Paul Bocuse Institute, Lyon). The interviews covered a description of these facilities, their day-to-day business, but also their potential interest in a RICHFIELDS infrastructure (data needs and wants, what they could offer, what they would want in return etc.).

The results obtained in the above described activities have been discussed at a range of events, both internally (within the RICHFIELDS consortium) and externally (with potential stakeholders). Feedback was obtained on suggestions, recommendations and ideas for the design of the RICHFIELDS RI. The present report is a summary of the main findings across these various tasks including the feedback that was gathered, and a synthesis of these into a set of recommendations for the design of the RICHFIELDS RI.

The main themes that emerged from this round of stakeholder feedback are the need for **high quality data** that have been checked and can be **trusted**, clear-cut **rules on how to access and use** them and a **catalogue** of existing research endeavours including a repository of study protocols to map . These aspects are closely linked to the need for **data standardisation** and **harmonisation**. Making data comparable is the key functionality in order to share, co- and re-use them across researchers of various disciplines.

From a business model perspective, a hybrid solution seems most suitable. Publicly funded research laboratories and facilities often 'belong' to a university or a broader academic body which can sometimes restrict them in their openness to outside parties. A purely public RICHFIELDS funding model would hence make it more difficult to incorporate the food industry, food retailers and commercially generated data into the RI. Business models relying entirely on private funding, on the other hand, may have the same effect in reverse. Due to commercial interests, broad access to research-generated data may not be fully pursued here. Again, a loss of access to one of the major stakeholders in this framework, researchers, could be detrimental to the long-term success of such an RI. Consequently, only a public-

private funding model bears the capacities to deal with the tension between adhering to all European/national quality standards and be eligible for public funding, while securing continuous external funding from outside sources, through commissioned research. A hybrid solution seems most suitable to manage this balancing act and successfully connect all parties.

RICHFIELDS's first and foremost objective, in a nutshell, is that of connectivity. Connecting data providers and users along a range of features (e.g., catalogues, search engines, network opportunities) will be the way forward in successfully establishing a research infrastructure.



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1 Work package 10: Connecting laboratories and facilities

Work package 10 (“Connecting laboratories and facilities”) as part of phase 2 of the RICHFIELDS project has had the objective to identify a diverse set of laboratories and research facilities across Europe, better understand their structures, their data needs and wants but also their added value and the services they provide which could be linked into a future RI on consumers, food and health.

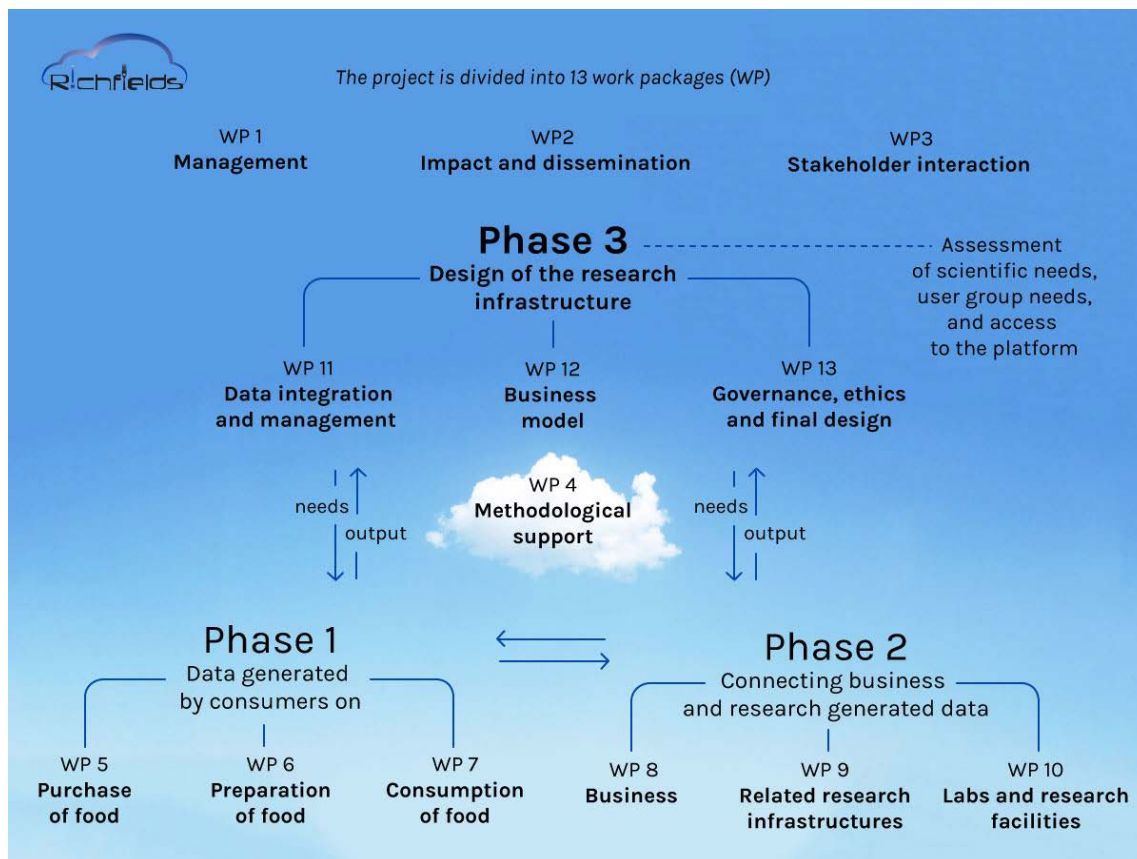


Figure 1: overview RICHFIELDS work packages

Phase 2 has been designed to inform the RICHFIELDS consortium about business and research generated data, as opposed to consumer generated data which phase 1 has focussed on. By understanding a) what is out there, meaning which different types of labs and facilities exist and carry out research (i.e. produce data, protocols etc.) and b) studying a selection of these in depth, it was hoped that more insights could be gained as to how the RI needs to be set up in order to be of value and to create value for research-generated data providers and users. All activities were driven by a set of questions including “what do research generated data look like and how could they be linked/shared in order to create more value?”, “what are the data needs and wants of these labs and facilities and what would RICHFIELDS need to offer them in order to create more value?”, and lastly “what would a RICHFIELDS RI gain from

connecting research laboratories and facilities, sharing their data and study protocols and offering additional services?”.

1.1 Objective(s) of work package 10

Building on the above elaborations, the objectives of work package 10 were summarised into the following set of questions that have been consistently asked across all case studies and interviews:

- 1) How are European laboratories and facilities on food choice, purchase and consumption structured?
- 2) How are IC technologies used to capture the food choice, purchase and consumption data and how/where is it stored?
- 3) How do the experts running these selected laboratories and facilities evaluate the data access, exchange and linkage to external RIs? What would be the challenges and constraints to expand the access?
- 4) What are potential ethical issues related to such a linkage into an RI (e.g., data privacy, ownership rights etc.)?
- 5) Which recommendations can be made on the design of future data structures and interfaces of consumer research laboratories and facilities, taking into account a pan-European research infrastructure such as the one proposed by RICHFIELDS?

1.2 Case study approach

Driven by a need to better understand which laboratories and research facilities exist across Europe and how they are structured, a set of case studies was developed, describing and exploring selected laboratories in detail:

- 1) Fake Food Buffet, ETH Zurich (and additional replications which have been set up at universities in Germany, England and Australia): deliverable report D10.3
- 2) FoodScape Lab, Aalborg University Copenhagen: deliverable report D10.3
- 3) Restaurant of the Future, Wageningen University: deliverable report D10.2

For this purpose, a shared protocol for all phase 2 activities had been developed, to ensure that similar activities (e.g., interviews, case studies etc.) would follow similar patterns and approaches and possibly make the results comparable, even if collected across different sectors. One outcome of this protocol was a table of contents (overview of chapters) that both work package 8 and 10 activities adhered to.

- a) **Description of the facility** (e.g., what equipment does the facility have, which study designs are possible and which research questions can be answered; what business

model underlies the facility, meaning how is it financed, run, maintained, and can external stakeholders commission studies and for which price etc.)

SERVICES: what types of services does the facility already offer? What could become possible in the future?

EDUCATION: what role do these laboratories and facilities play in the education of young researchers?

- b) **Structure of the data** (what type of data that is collected, which type of data is available)
- c) **Technology/ies and devices** used to collect, store and access the data (how is the data captured, e.g. manually vs. fully automated, and how do the technologies and devices feed into the local data bases; what are possible interfaces and how can this data be accessed, both internally and externally)
- d) Potential **link into RICHFIELDS RI** (how can the data generated in this facility be linked into a larger, pan-European research infrastructure and what are the benefits and challenges of doing so, e.g. gate keeper, application process, rules to access the data, maintenance, contact point etc.)

ACCESS: what challenges are there in making the data available across local or national borders, e.g. language, currency or decimal system?

- e) **Governance and ethical issues** (who has ownership rights of the data; are there privacy issues that need to be taken into account before making the data available through an RI; what requirements are listed for consumers to participate and what type of consent form do study participants sign; to what extent are the data anonymised and which ethical guidelines and standards are applied to the study designs)

This overview provides an understanding of the content dealt with in the three case studies developed and described for RICHFIELDS. Chapter 2 will summarise the main findings from these case studies in relation to the design of the future RICHFIELDS RI. This includes the needs and wants, but also added value of potential users, customers and financiers of the research infrastructure.

1.3 Mapping laboratories and research facilities in Europe

Building on the insights gained from the above described case studies, a mapping exercise was undertaken to identify various laboratories and research facilities across Europe – both in terms of geographical coverage but also, and most importantly, in terms of the breadth of different purposes, activities, different types of data collected and different funding models. The outcome of the mapping exercise can be found in the deliverable report D10.1.

Once the mapping exercise had been carried out, it became clear that a variety of different funding/business models are in use for these laboratories and research facilities. Mainly, they

differed in their purpose, meaning who was funding them to do what and why. This distinction was ultimately translated into three main funding models: private (often driven by industry, either individually or in collaboration – alternatives included consulting services), public (mainly driven by universities or national research collaborations) and public-private as a combination of the above. Taking into account that all three case studies developed in deliverables D10.2 and D10.3 were focussing on publicly-funded laboratories (i.e. run by universities), it was decided to select one representative each of the private and the public-private funding model that the mapping exercise had produced and interview these facilities in more depth, to obtain additional insights. The facilities chosen were the Nestlé Research Centre, Lausanne (private funding model) and the Paul Bocuse Institute, Lyon (public-private funding model). Results of the interviews can be found in the deliverable report D10.1.

Chapter 2 will synthesise the findings reported in the above described activities, with regards to the design of a RICHFIELDS RI.

Chapter 3 then builds on these insights by adding external feedback received through stakeholder events and workshops where this work package and its results was presented and discussed.

2 Synthesis of findings: what work package 10 recommends

The design of a potential RICHFIELDS RI is concerned with a number of factors, including its functionality, what services to offer, the added value it shall represent to its users and financiers, and governance/ethics questions. Additionally, as part of the business model development, the question of users has been dealt with in great detail. Who will supply data, who will use the data, and under which conditions?

2.1 Insights from publicly-funded research facilities

An analysis of three separate case studies (Fake Food Buffet, FoodScope Lab and Restaurant of the Future) provided insights into how research data generators (i.e. laboratories and research facilities) would respond to the above questions.

A number of future applications for these research facilities could be identified and built the starting point for a set of recommendations for the design of the RICHFIELDS RI. Such extensions include: a virtual version of the FFB (using digital scans of fake foods), research on the odour of food choice and meal composition, a combination of the FFB with other technologies such as eye tracking or the intelligent buffet and lastly an automated food and volume recognition of fake foods. Similarly, the FoodScope Lab and the Restaurant of the Future would benefit from (more) international cooperation that could result in stronger and

more robust study protocols as well as the standardisation of experiments across labs of similar structure.

Such needs open up possibilities for RICHFIELDS to provide access to other research institutes, facilities but also increased digital solutions to expand the research currently undertaken in these facilities. On the other hand, the laboratories could be potentially interested in external parties undertaking studies at their facilities as the inventory and the maintenance represent significant costs the university currently has to cover itself.

RICHFIELDS could serve as a connector, in bringing together the research facilities and other stakeholders who would be interested in carrying out (commissioned) research. This includes both applied and academic research, particularly as part of the education and training of young researchers (graduates and undergraduates) from other universities.

On a data level, the FFB, the FoodScape Lab and the Restaurant of the Future could provide study protocols to RICHFIELDS which may help carry out similar studies at other research laboratories and facilities but they can also offer guidance on variable definition and outcome calculation (e.g., identification of portions, nutrient equivalent computation etc.). The sharing of study protocols, variable definition and data sets through a RICHFIELDS RI can help in several aspects: 1) Replication of findings and extension, 2) Comparison of findings between countries, 3) Meta-analysis and review for existing research and lastly provide 4) a database of study protocols as a starting point to set standards.

Services provided by RICHFIELDS to research facilities and laboratories could include:

- **Best practice:** making study protocols accessible to other researchers can help optimize the study procedures, designs and methods
- **Validity:** supporting the validation of methods applied at the research facility across countries, samples and foods (e.g., access to more effect sizes and sample size estimations from other studies applying the same methodology)
- **Extension:** a network of research facilities and laboratories can help expanding the existing databases with new products (fake, virtual and real products and their nutrient composition)

On the other hand, incentives for research laboratories and facilities in joining a RICHFIELDS RI include:

- **Scientific reputation** and increased citations of the methods applied at the facility
- Possible **collaborations** with other academics, i.e. research collaborations, joint publications, exchange of staff between universities (fellowship programmes), up to joint research grant applications

- **Contract research or tenders**, i.e. external funding from private research institutes or the food industry which would enable maintenance, extension and replication of the existing fake food labs in even more countries and at even more universities
- **Method validation** (validation of further foods) and extension of the existing fake food database with additional foods
- **Cooperative/multi centre studies**, country comparisons
- **Education and training** of staff
- **Technology development**

At the same time, the case study analysis also highlighted that intellectual property rights (ownership of data, consent given by study participants) present a significant challenge in sharing data generated at facilities like the FFB, the FoodScape Lab and the Restaurant of the Future. How the governing rules and access rights will be defined at the RICHFIELDS RI will likely be the decisive factor in whether these research laboratories and facilities are interested in becoming an active partner.

2.2 Insights from a public-privately funded research institute

An additional in-depth interview was carried out with the Paul Bocuse Institute (PBI) in Lyon, France, based on the outcome of the mapping exercise.

The interview provided additional insights into needs of facilities that work both in the public sector (e.g., national and European research funding) and on commissioned research. Clearly, with their expertise and the facilities on site (e.g., experimental restaurant, FLOW app), the PBI presents a valuable partner in research on meal choice and consumption behaviour. As such, a research infrastructure that brings together researchers of various institutes, to carry out joint projects, would provide great value to both the PBI and other parties involved in research on consumers, food and health.

Data sharing, however, will underlie strict regulations as the PBI has to comply with the requirements of the French consumer protection agency (CNIL) and for biomedical research, with the Ethical Committee CPP. Furthermore, consent forms to date guarantee participants that their data are not used for purposes other than research. Corresponding “terms of use” will be necessary as part of the RICHFIELDS RI to successfully offer ways of data exchange. This could also be important when data generated from an industry-commissioned project are to be shared, as questions of ownership will have to be defined in advance.

PBI identified three additional needs that a research infrastructure could fulfil:

A need for replication. Existing studies need to be replicated in other settings, in other countries and on other samples, in order to strengthen the body of evidence. Here, the

network provided by a research infrastructure could prove valuable in bringing together researchers across the globe to share research ideas, data sets and study designs to foster replication studies.

A need for more overview. It has been suggested that a catalogue of some sort would be useful to inventory existing research endeavours (past, present and future) – both those that worked and those that didn't. This would especially include study protocols where sharing could be easier due to their pre-competitiveness as no specific data and results are linked to these. Young researchers can orientate themselves and use these protocols as building blocks for their own study design. Other researchers may want to see whether someone else has already worked on something they are interested in.

A need for standardisation and harmonisation. Endeavours such as a study protocol repository and a research inventory for various topics can help move the community towards more standardised research approaches that make studies comparable and enable meta-analyses to further strengthen the body of evidence. Examples for standardisation could include rules for data collection, methodology and variable definition but also the common use of food composition data bases.

In sum, RICHFIELDS should offer a repository for study protocols, guidance on data standardisation and harmonisation and ideally a powerful search engine to enable researchers of various disciplines to look up existing research projects as well as other research facilities with which they can collaborate and exchange ideas, expertise and staff.

2.3 Insights from a privately funded research institute

An additional in-depth interview was carried out with the Nestlé Research Centre (NRC) in Lausanne, Switzerland, based on the outcome of the mapping exercise.

The interview provided valuable insights into a research facility that is run as part of a food company, including its interests and needs in research on consumers, food and health. They range from fundamental research into consumers' health and nutrition status to behavioural research regarding specific products all the way to commercially driven studies on consumer preferences. This distinction also allows for a better understanding of what a privately funded research facility is interested in and what could drive their need to connect to a research infrastructure. Basic (behavioural) research endeavours require more collaboration across disciplines and even facilities, due to their complexity and their widespread research questions. Compared to that, commercial applications (e.g., novel product development and consumer liking/preferences) are carried out in isolation, so as not to endanger the competitive position of a manufacturer.

The NRC identified a number of needs that can only be met through more collaboration and access to other research, including individual-level intake data that reflect the entire consumption throughout the day (from in-home to out-of-home contexts, across all foods and drinks that are consumed – not restricted to a certain brand), including portion and meal sizes, and how to better connect these data sources, for analysis. Furthermore, a role model of some sort on how to store, centralise and link existing data was seen as useful. Here, RICHFIELDS could serve both as an example and a model repository of some sort, for all data that commercial stakeholders are willing to share. This would become especially important with regards to the standardisation and harmonisation of data (e.g., collection method, data structure and description like variable names etc.). The example of clinical trials for which there are standardisation protocols and procedures in place was named in this regard. It would present a unique benefit for a research infrastructure to provide such a widespread scientific field like the one on consumers, food and health with guidance on standardised protocols and procedures for data collection, description, storage and possibly analysis.

The interview also provided an example of where NRC has shared data with an external partner, the Global Dietary Database (GDD). Here, data can only be provided if it follows the structure determined by the GDD. If RICHFIELDS were to eventually host data itself, this model could serve as an example of how to allow data providers to share their data and what structure such data sets would require. In turn, the GDD offers its data providers to put forth research questions they are interested in – an option RICHFIELDS could also pursue, to offer both an incentive and a benefit to its data providers.

Lastly, potential issues around the ownership of data would need to be discussed in a RICHFIELDS RI. Currently, NRC reports that they retain complete ownership of their data, even when sharing with external parties. A future RI will need to respond to those needs when the “terms of use” are defined.

As a conclusion, the need for and interest in collaborating and sharing data for a more comprehensive access to different aspects of consumption was highlighted.

3 Internal and external stakeholder feedback

At various stages of the work carried out in this work package, both internal and external (public) feedback was gathered. This included discussions among project partners involved in work package 10, phase 2, and ultimately the entire RICHFIELDS consortium, as well as feedback gathered from external stakeholders, at a number of events.

3.1 RICHFIELDS exchange – meetings and events

The main events where RICHFIELDS findings were discussed are listed below, followed by a summary of the feedback that was received at these events.

- July 5 2017, ICCAS Conference “Understanding the Digitalisation of Foodscapes” (Copenhagen, Denmark)
- June 7 2017, Workshop on Fake Food laboratories at the conference of the International Society for Behavioral Nutrition and Physical Activity (ISBNPA) (Victoria, Canada)
- April 4 2017, 2nd RICHFIELDS Stakeholder Workshop (Brussels, Belgium)
- March 7-8 2017, Plenary Meeting RICHFIELDS (Gothenburg, Sweden)
- March 1 2017, Multi-stakeholder workshop on Big Food Data (Copenhagen, Denmark)
- June 28-29 2016, Plenary Meeting RICHFIELDS (Milan, Italy)
- January 18 2016, Internal project meeting on phase 2 update (Skype)

3.2 Feedback summary

Interest in RICHFIELDS: generally, researchers across a spectrum of different disciplines voiced their interest in this endeavour, citing high-quality data they currently do not have access to as the main reason. The quality of what RICHFIELDS could offer, the *added value*, essentially makes or breaks interest in the RI. Ultimately, RICHFIELDS will have to provide something that stakeholders cannot obtain elsewhere or that is much easier to obtain/access via RICHFIELDS than elsewhere. Such added value would already start by offering a sort of catalogue of existing research, study protocols, data or even just partners and research facilities with whom to collaborate. Expanding researchers’ access to actual data could include smaller features such as data from other countries (e.g. population intake studies) or data that all use the same standardisation protocol (i.e. rules of data collection, methodical descriptors or variable definition) but it could also entail the creation of a network in which researchers can exchange and ultimately collaborate with one another. As an example, individual-level intake data was cited: by working together, de-identified data could be collected on the entire food intake of individuals including in-home consumption, out-of-home consumption and possibly health and nutrition status parameters. That way, both

consumption patterns but also holistic effects of nutrition intake on health status could be studied.

Another aspect that was mentioned by a range of researchers focussed on the **rules and regulations** within the RI. A clear terminology would be needed to clarify the purpose and the processes, for example: are data provided, donated, shared etc.? What do these different terms mean and what are their consequences? Consequently, RICHFIELDS would have to develop clear “**terms of use**” of the data and study protocols provided within the RI that detail how the data can be used, what type of application(s) must be submitted in order to be able to access the data, how new findings could be published (e.g., authorship, acknowledgement, funding etc.) and which rules needed to be taken into account (e.g., only Open Access publications, provision of the new data sets in repositories etc.). Clear terms of use would benefit both the data provider and the data user. Transparency was considered key in ensuring that data would not be used against their purpose or – from the research perspective – for commercial purposes they were not intended for.

Linked to the discussion around RICHFIELDS terms of use, researchers mentioned the importance of **establishing trust** with a data provider (and correspondingly with the data user). At several instances, they told their experiences with sharing data or working with data providers where mutual trust played an important role, both in terms of the quality of the data but also the purposes for which this data was then used. This insight will be important when it comes to branding RICHFIELDS and creating an image. It will require technical features such as terms of use, transparency statements and governance aspects. But it will also require the building of networks and relationships among European (and potentially global) stakeholders from academia/research, industry and policy.

Education: an interesting aspect that several stakeholders mentioned focusses on the training and education of young researchers. Being able to access data and most importantly study protocols through a RICHFIELDS RI would provide great support for students of all sorts, to better understand how other (seasoned) researchers have carried out their research, how they designed their studies and how they labelled their data variables. By offering such guidance, more informed research could be created, both to replicate existing findings and extend knowledge in a given field through novel studies.

Monetising services: when dealing with researchers, the RICHFIELDS RI will have to provide attractive access options that do not present a barrier for them to use the RI. Many researchers currently would expect such an RI to be free of charge or at least have their access covered by a framework contract with their university. But there are also researchers that are not currently associated with a university that would want to be able to access the RI without hefty fees.

Services created in order to monetise the RI were also discussed. At one event, they were coined “knowledge generation”, a type of academic consulting service whereby data analysis, presentation, recommendation and guidance on specific research questions could be offered to industry in exchange for access to their data or even direct payments. Such services could be expanded into trainings, workshops and networking opportunities that could be offered through RICHFIELDS, to better connect research and industry.

The **challenges** perceived by the stakeholders are manifold but do indeed provide valuable input into the design of a RICHFIELDS RI.

- **Informed consent:** it was discussed whether consent would no longer be informed when data could later be shared with other researchers, through an RI, and could potentially be used for purposes other than the ones the data were originally collected for.
- **Compatibility:** even if access to all available data on consumers, food and health could be provided, the lack of compatibility between these data sets might render them useless to some researchers. It could be something as simple as the data format (Excel, SPSS, STATA, R etc.), the language the data have been collected in, the units used (e.g., metric system) or the names of the variables contained (e.g., variable code books). But it could also refer to the way the data have been collected, e.g. in an experiment where the dependent variable was x but now researchers might be interested in the dependent variables y and z.
- **Usability:** researchers were concerned that the data provided by RICHFIELDS might not be as useful as hoped for, because they hadn’t been cleaned or they had focussed on different research questions. While the latter can only be dealt with once RICHFIELDS has reached a critical mass in terms of data linkage (i.e. enough links are available so that everyone will find what they need), data cleaning could be included as a requirement for all data providers, in order to be allowed to share their data. This could then also entail a variable code book that properly explains the data set.
- **Trustworthiness:** lastly, it was mentioned that data sets created by others, especially when those “others” are not personally known, could incite a certain level of suspicion as to their quality. RICHFIELDS would need to ensure some kind of quality check that would put researchers at ease that the data they access through the RI are of a quality comparable to the standards they operate on. Ultimately, such thoughts lead to a quality stamp, or a stamp of approval provided by RICHFIELDS as the European standard in consumer, food and health data. While this may remain a vision for now, it certainly could be made RICHFIELDS’ mission to attain such a status.

4 Conclusive remarks

The main themes that emerge when it comes to discussing an RI on consumers, food and health, are the need for high quality data that have been checked and can be trusted (i.e., some form of RICHFIELDS approval stamp), clear-cut rules on how to access and use them (e.g., terms of use, access rights, publication procedures etc.) and a catalogue of existing research endeavours (e.g., a repository of study protocols) that would allow for consistent research designs when the aim is to replicate findings but also to inform the design of novel studies no one has done yet. These aspects are closely linked to the need for data standardisation and harmonisation. Making data comparable (e.g., method of collection, variable definition etc.) appears to be a key functionality in order to share, co- and re-use them across researchers of various disciplines.

From a business model perspective, it has become clear that each model bears their advantages and disadvantages. Publicly funded research laboratories and facilities often 'belong' to a university or a broader academic body which can sometimes restrict them in their openness to outside parties, for example the food industry, in carrying out joint or commissioned research. This could be transferred onto the RICHFIELDS RI in the sense that a purely public funding model could make it more difficult to incorporate the food industry, food retailers and commercially generated data into the RI. A loss of access to these insights, the data and the possibilities of collaboration would ultimately be the demise of such an endeavour and as such cannot be recommended. Business models relying entirely on private funding, on the other hand, may have the same effect in reverse. Due to commercial interests, broad access to research-generated data may not be fully pursued in such a funding model, for example because the data are in a pre-competitive or competitive stage of the product lifecycle. Again, a loss of access to one of the major stakeholders in this framework, researchers, could be detrimental to the long-term success of such an RI. Lastly, public-private funding models highlight the tension in which such institutions operate: adhering to all quality standards in order to strengthen the reputation and be eligible for public funding, while securing continuous external funding from outside sources, through commissioned research. Surely, such a balancing act would also apply to a public-private funding model for the RICHFIELDS RI, but in terms of connecting all parties in order to share and collaborate, this option is the most inclusive one.

Both from the content and the business model point of view, it seems that RICHFIELDS should first and foremost serve the objective of connectivity. Connecting data providers and users along a range of features (e.g., catalogues, search engines, network opportunities) will be the way forward in successfully establishing a research infrastructure.