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Executive summary

The RICHFIELDS project is aiming at designing a future research infrastructure (RI) for innovative research on healthy food choices, preparation and consumption of food and drinks among EU citizens, closely linked to their general behaviour and lifestyle. The focus in the WP8 has been data users and providers looking at domestic/retail relations - business to consumer (B2C) and data users and providers looking at professional trade between food service suppliers and their customers in the public - business to governments (B2G). The findings have been reported in three different reports/deliverables (D8.1, D8.2 and D8.3) covering the following three themes: best practices, IC Technology and stakeholder views. The key findings from the three deliverable reports (D.8.1, D8.2 and D8.3) forming the basis of the draft recommendation report include;

D 8.1 Best practice:

- RI should establish minimum data holding duration and be able to negotiate for exemptions on data expiration or holding extension purposely for research.
- RI data requirements should put emphasis on measures that address data provider's error correction strategy.
- Data sharing collaboration should permit data provider to access their own data and other database in RI and get feedback on usage of their dataset.
- RI business model should help data providers gain financially from organizations or institutions using their data for commercial purposes.

D 8.2 ICT

- A continuous engagement with data providers as essential to ensure that the research data infrastructure continues to meet researchers' needs.
- That interfaces should be compatible with the ICT structure of any research infrastructure/platform, e.g. through thorough data descriptions (ontologies, variable descriptions etc.) that are available for each data set collected with such advanced technological devices.
- Cloud based integrated ICT solutions for in-store analytics have the capacity to incorporate all existing ICT as data sources. Such a solution might be the way forward for any future data research platform.

D.8.3 Stakeholder views

- The research community would like RICHFIELDS to guarantee data quality, validity and compatibility while the business representatives were more interested in how RICHFIELDS can help with their data needs and what value RICHFIELDS can provide for them.
- The RICHFIELDS platform needs to have an interface that would allow researchers to browse and analyse data in order to fully realize the scientific potential of the platform.

- The platform should give feedback to data providers about when and for what purpose their data is being used
- The platform could only handle aggregated data in order to avoid legal and ethical issues. However, care needs to be taken even when linking aggregated data from different sources that could potentially lead to identifying an individual.

As outlined in the project protocol, we arrived at the final report by synthesizing the D.81, D.8.2 and D.8.3, together with the insights gained from the stakeholder workshop held in Lund, Oct 3rd, 2017 and summarized the recommendations that should be provided to phase 3 for the design of Richfield RI. The final report therefore provides research based recommendations covering aspects of ICT, Governance and Business model of a research infrastructure.

Information Communication and technology of the research infrastructure.

 A research infrastructure is a complex technical undertaking and needs to deal with several important aspects of which some of them are: How can different data sets be integrated to create new insight and how can the necessary data security and seamlessness be created. What kind of computer technology in terms of hard- and software is needed? How can data maintenance and data management be taken into account? How should the quality assurance of data be organized and how could data access be organized in a proper way? The following key recommendations were made:

RI functionality and design

- The RI should therefore be flexible enough to be able to respond to this dynamic ICT environment.
- The RI needs to be able, flexible and adaptable to facilitate data exchange from new and unexpected data source.

RI data standardization

Incompleteness of data

The RI needs to ensure completeness of supplied data, preferably raw data, possibly by data management feedback to data suppliers.

Missing or erroneous information

The RI needs procedures for scrutinization of supplied data. As, the data may contain uncertainties, it is important that the RI has sufficient insight into the data collection processes.

Governance of a research infrastructure.

A research infrastructure is a dynamic phenomena that needs to be ruled by actors and take decisions according to those rules. A governance structure thus needs to relate to such aspects

as: Who should decide what? Which stakeholders should be involved in the operation of the structure? Which stakeholders needs to be kept informed about the infrastructures and who could contribute? Which privacy issues are important to take into account? The following key recommendations were made:

Data access permission

The RI needs an overall EU legislation around data sharing with EU-level research institutions in order to avoid having to negotiate terms and conditions with different data providers in different countries.

Access agreement

Thus, the proposed RI should adhere to specific EU policies on data handling, data aggregation and disclosure to meet the concerns of data providers.

The RI needs specific EU policies on data handling, data aggregation and disclosure to handle non-aggregated data, which allows identification of companies and their associated customer base.

Access privacy issues

That the RI carefully considers the optimal current and future use of social-media related data in the platform, preferably in close dialogue with relevant data providers.

Access permission.

The RI needs an overall EU legislation around data sharing with EU-level research institutions in order to avoid having to negotiate terms and conditions with different data providers in different countries.

Business models for a research infrastructure.

A research infrastructure is an organization that needs to be organized as a business. That means that a plan should exist of how the infrastructure could generate income. Who should be paying for using the structure and what should prices be? How could the infrastructure be organized in a way where both the concern for cooperation on hardware and labs including cooperation and sharing of devices, sensors, protocols and equipment be provided for and at the same time cater for the cooperation aimed at sharing and cooperation of the more soft data part? The recommendations include:

The RI may need to consider different business models, e.g. direct payment for used data, with different data providers, where the mutual benefit aspect must be taken into account.

The business model could be considered in terms of paying for any data they use or allowing for use of data that may not have competitive advantages.

That data providers could be given give free access to the RI as a form of compensation or incentive to motivate data sharing.

Develop strategies that could help exclude entities and businesses organizations likely to have competitive urge over their counterparts in sharing data on the RI to further the course of researchers' effort to address societal challenges.

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1. Introduction

The purpose of the work package (WP) 8 has been to investigate how different institutions collects data about consumer behavior -business generated data. The catchment area for the work has been Denmark and Sweden and four cases were selected for in depth study. The main focus has been data users and providers studying the business to consumer (B2C) interface and data users and providers looking at the business to government interface (B2G). The findings have been reported in the three reports: *Business Generated Data Case Studies* (D8.1), *ICT used for extracting business generated data* (D8.2) and *Stakeholders workshop report* (D8.3). The three reports aimed to cover following the three topics: analysis of best practices of collecting data, IC technology used for their data collection and stakeholder views on perspectives in sharing of data in data pools. After a synthesis of the findings the results, the draft recommendation report was presented at the Nordic stakeholders workshop and collected at the same time feedback from a broad range of Nordic stakeholders representing academia, business and civil society to finalized this recommendation report. The report therefore makes relevant recommendations that should provide phase 3 with inputs for the design of a future research infrastructure.

2. Methods

The recommendation provided in this report is line with the project protocol. The final recommendation report was accomplished using two level tasks. First, the synthetization of findings from across activities 1-3 to develop a draft recommendation on future RI. Secondly, the WP 8 team organized a one-day's workshop, in collaboration with partners WP3, WP9 and WP10 based on a developed protocol for policy briefings. RF partners in the Øresund area and invited Nordic stakeholders to discuss insights so far from the RF study and to discuss how a future European research infrastructure can be created in a way that would add value for a broad range of stakeholders in the Nordic and European food sector. The draft recommendation was be presented to all partners and stakeholders at the project workshop. Themes of the workshop from WP 8 perspective covered the following: Data linkages and interfaces, user needs, access policy and routines and scientific potential assessment. Discussion was be initiated, and views of the workshop participants were be sought on the specific recommendations made. Recommendations were assessed in the light of these discussions and refinements were made where appropriate before finalizing the recommendation document. A total of 30 participants from the academia, business and RF project partners attended. The progress of the work carried out in WP8 is illustrated in figure 1.
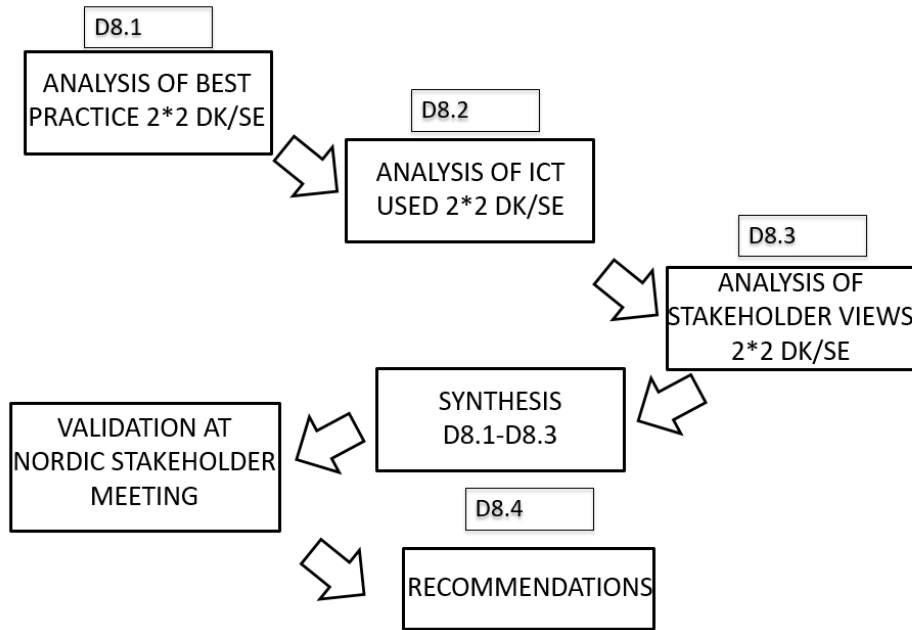
Figure 1. Flowsheet for work package WP8. The figure 1, illustrates the activities conducted in the WP8 leading to the final recommendation report.

3. Recommendation

ICT, maintenance and the research infrastructure.

Data integration & management

The following themes relating to data integration & management was identified as important requirements and specifications from potential users in the consumer research and intelligence community

Need for diversity of data sources

Based on the conclusions in WP8 D8.1 it was found that the scientific reach is dependent on the diversity of data sources, that is data generated by different businesses available for the proposed RI. As can be seen from the associated company descriptions, the RI may incorporate data from example retailers, public procurement companies, statistical institutions and market organizations. With such diversity, the proposed RI is more likely to successfully undertake e.g. broad EU-level socio-economic and consumption behavior related research questions. With different kinds of data providers of different sizes, the RI ensures sufficient inter- and intra-regional data coverage with different levels of data resolution in the EU. The RI should devise strategies to address the possible challenges of that harmonization. *This could be considered in terms of standardization of data collection method for the data providers. In addition, the RI should provide analytic functions with capable of bringing data from diverse source together and link up, such that it can generate harmonized data, a format needed for analysis.*

WP8 D8.1 could also conclude that differences and reasons for data generation may also affect the scientific potential of the RI. By looking at the case studies for the public procurement company and statistical institution, data generation is significantly governed by policies to control suppliers or follow organic procurement, which may put limits on the broadness and the potential usefulness of the data for scientific purposes within the RI. On the other hand, the retail and market organization case studies show potential to collect data from a broader consumer perspective, thus reflecting a more generic usage potential. It is thus important for the proposed RI to be aware of differences in data generation purpose and influence relevant data providers according to the needs of the scientific cases. The RI needs to ensure data source diversity in collected data, mainly due to differences in reasons for data collection and associated generic data usage potential for EU inter- and intra-regional research.

User and provider needs

The results from the stakeholder workshop in WP8 D8.3 also provided important input to the RI design process by further emphasizing user and provider needs in the proposed platform. In the stakeholder meeting two separate user and/or provider groups were considered: researchers and businesses. For the user and provider needs the following conclusions were drawn from the stakeholder meeting:

- The benefits of a RI platform for academia lie in having access to more complete data from different fields or perspectives of consumer food behavior and health (e.g., food composition data, nutritional intake, GS1 barcode data, purchasing data, consumer attitudes and perceptions) which could accelerate consumer behavior research. Interestingly, the academia were very caution in proposing scientific questions that could be addressed by having these wider and standardized data. It was considered that scientific questions should be of reflection of public health challenges and possibility of getting access to appropriate right dataset to solve it. Linking data from different domains could lead to modelling of consumer behavior in their daily food environment. This could for example give new insights to the relative importance of individual, environmental and legal measures to enhance a healthy diet pattern (as a whole, or of certain health/adverse food groups in particular). Furthermore combining more data on the same topic adds strength to generalizability and robustness of conclusions. Ultimately, this could help in answering specific questions on whether e.g. certain labelling or advertising techniques affect consumption of soda drinks.
- The research community would like the RI to guarantee data quality, validity and compatibility.
- An interface that would allow researchers to browse and analyze data would be required in order to fully realize the potential of the RI platform.
- Linking data from different sources is a difficult task, but would make the RI a unique platform.

Businesses as users and providers

The following lessons were drawn:

- Businesses would like to have access to services provided by the RI platform i.e. become users of the platform. Businesses would like to have free access to the RI platform in return for providing the data to the platform.
- Companies are willing to acknowledge their responsibility to improve public health as an incentive to data sharing.
- It is unlikely that they would donate their data for purely altruistic reasons.
- Sharing data with an RI is perceived as a risk as data could be exploited by competitors to gain a competitive advantage.
- Sharing data is also considered a risk if data could be used in an unethical way.

By taking the overall results from WP8 D8.3 into account, the following design recommendations may therefore be considered:

Needs of data users:
- User need: A powerful **search engine** would be needed to find relevant data for specific **research** questions
- User need: Easy and non-time consuming access to features that would allow tracking **a cohort of consumers** over several years would be of interest
- User need: Offering **analysis and interpretation services** for the data available on the platform could spike interest in users
- User need : Feeding results of the research back to the RI that could be accessed by businesses that provided the initial data would make an **engagement in the RI** more attractive for businesses
- User need: Data exchange should be **straight forward and easy to understand**
- User need: The platform should provide information about **how the original data was collected** by the data provider (METADATA)
- Users need: **create added value by exploiting available data**. Companies are collecting data that is just being stored as they do not have the knowledge to analyze the data in a meaningful way. Nevertheless, companies from many sectors of commerce are putting an increased focus on how to create value from their data. Allowing access to this data through the RI could give new insights to companies on how the data can be used for commercial purposes.

Needs of data providers:
- Provider need: The platform should give **feedback to data providers about when and for what purpose** their data is being used.
- Provider need: **Case studies showing the benefits of data sharing for businesses** could be developed in order to more easily persuade businesses to share their data with the platform.

Communicating scientific potential of a research infrastucture
A key point from the WP8 D8.3 workshop was that terms like "Research Infrastructure" and "platform", but also the core offering of the RI idea, is not well understood among non-

consortium stakeholders participating in the workshop. Thus, it might be useful for the project to be more clear and strategic in the communication with the research community and other external stakeholders.

The scientific potential of the envisioned RI platform could be enhanced by (taken form the bullets underneath):

- Combining and linking data from many data sources, for example food sales and consumer purchasing data generated by different organisations. This could have the potential to answer numerous research questions related to food quality, dietary behavior, and public health.
- A data philanthropy model for the RI should be explored where data donations would come both from businesses as well as consumers. This could lead to more complete data and increase the scientific potential of the RI.
- Researchers, apart from being data users of the RI, could also provide datasets, these be could raw and aggregated data to further enrich the platform.
- The RI could have long term benefits if it can contribute to creating awareness and a culture of data sharing, data donation, data philanthropy and the idea of citizen science.

RI functionality and design

Overview of ICT technologies

The case studies in WP8 D8.2 highlighted relevant ICT technologies that the proposed RI may need to interact with in associated data integration and management processes and the detailed findings are presented in Table 1. The data capture technologies essentially ranged from barcode devices and self-scanners, web-based questionnaires and other computers. In terms of database management, SAS-, SQL- and Visma-Oracle-based solutions, as well as Microsoft Excel were used to handle data. Thus, the RI may consider using similar technologies for efficient data transfer between data providers and the proposed data platform. In WP8 D8.2 it was noted from the case studies that the usage of social media is mostly preferred for data dissemination purposes, e.g. through Facebook or Twitter, rather than in the data collection process. The main argument against using social media in data collection is the difficulty in analyzing and controlling data integrity and quality in unstructured data. However, the future usage and adoption of data collection methodologies through social media cannot be excluded at this point.

- Thus, from a WP8 perspective, it is recommended that the RI carefully consider the optimal current and future use of social-media related data in the platform, preferably in close dialogue with relevant data providers.

Table 1. Overview of technologies. The table lists the IC technologies relating to each of the 4 case studies.

IC technology	Market organisation	Statistical institution	Retailer	Public procurement company
Data capture Technology	Digital barcode scanner Mobile device using barcode app	Web-based questionnaire	Self-scanners, end-of-trip scanning equipment, cashier scanners and barcode generators	Computers for data entry
Database management	SQL Microsoft database for data storage, extraction, analysis and sharing	SAS software for handling tasks including the web survey questionnaire and data aggregation	Visma-Oracle using Microsoft Excel as a tool to visualize and present the results	Microsoft Excel to handle the supplier provided statistics/data.
Social media in use	Not yet adopted for data collection	Facebook, twitter for dissemination of survey outcome	Not yet adopted for data collection	Not yet adopted for data collection

The four case studies from WP8 did not fully succeed to map the current ICT technologies and those that may become more prominent in the process of capturing and collecting data on consumer behavior. Thus, in order to amend the findings presented above, a literature review was carried out. The review focused on collecting examples of hardware (devices, sensors) that enable data capture as well as software solutions used to analyze data from various data sources. For specific results, the reader is referred to Table 2 in Appendix 2, where the results are categorized by business sector, type of technology, specific technology used, devices facilitating data capture, type of data collected and examples of ICT solutions available. However, in the last stage of the literature review, selected ICT solutions are described in more detail. These examples highlight emerging technologies used by retail and marketing organizations for the data collection and analysis of consumer behavior, thus serving as an additional basis for recommendations on how the RI should or could be structured.

The type of technologies used by retail business to gather consumer data were divided into four categories (for details see WP8 D8.2):

- Consumer location sensing technologies
- e-commerce and mCommerce
- Social media
- Point-of-sale technologies

Similarly, for market organizations, some of the new and and emerging technologies enabling market research data collection include:

- Social media
- smart mobile phones (GPS tracking)
- Barcode app scanners, etc.

The results from the case and literature studies in WP8 D8.2 show that the ICT landscape is fast-paced and driven by an increasing connectivity of devices, increasing numbers of mobile devices used by consumers and cheaper and better sensors. The data analysis software solutions are becoming increasingly sophisticated, e.g. as they can now include multiple data sources such as data from video, Wi-Fi, Bluetooth, traditional Point-of-sale systems, mobile applications, management systems etc. Future ICTs may well be able to gather and analyze data from sources that are not yet on our mind set today. A proposed RI should therefore be flexible enough to be able to respond to this dynamic ICT environment. In a nutshell, the RI needs to be able, flexible and adaptable to facilitate data exchange from new and unexpected data source. Key emerging technologies, described in WP8 D8.2, that the RI should consider compatibility with already at this stage are:

- Growing mobile and online technologies for data gathering
- New movement sensor technologies
- Cloud-based integrated ICT solutions for in-store analytics like "RetailNext"
- (Deep) machine learning for human behavior prediction
- Future purchase data generation, i.e. the concept of "Amazon Go"

RI data standardization

Incompleteness of data

- WP8 D8.1 revealed a key point with respect to the scientific case, which is the possible incompleteness of data from potential data providers. The proposed RI may thus need to encourage certain data management procedures from their data providers, if deemed relevant to the scientific cases undertaken. For example, from the public procurement company case study, different levels of data aggregation were used in order to avoid handling too big data files. If, instead, the raw data could be supplied to the RI, the relevance to scientific cases may be higher. Further, data was only available four years back in time as of 2016, which creates a time frame constraint in terms of a potential scientific case. The RI needs to ensure completeness of supplied data, preferably raw data, possibly by data management feedback to data suppliers.

Missing or erroneous information

According to WP8 D8.1, missing or erroneous information in the provided data is something the RI must consider with respect to its use for scientific purposes. In the associated retail case study, it was pointed out that there may be problems to trace errors from data providers due to e.g. large assortments. On the other hand, in the market organization and statistical institution case studies, the data is cross-checked or error corrected in order to avoid false data. RI users (e.g., scientists, researchers and policy makers) that are not directly linked to the data generation process are thus more likely to question its trustworthiness. This may be due to the potential uncertainty in data from different data providers. The best practice is to

ensure that the data are corrected from the beginning and throughout the collection processes. Further it is important that the RI has a rigorous scrutiny around provided data.

- The RI needs procedures for scrutinization of supplied data. As, the data may contain uncertainties, it is important that the RI has sufficient insight into the data collection processes.

4. Governance of a research infrastructure.

Access strategy

The stakeholder workshop in WP8 D8.3 partly emphasized the results of WP8 D8.1, but also added important comments relevant to successful implementation of the RI services. The main results were:

- Companies attending the workshop were in general positive about the notion of making their data accessible for research purposes under the condition that there is a mutual benefit from the collaboration.
- Access strategy should account for the "age" of the data. Two important parameters were identified in regards to what type of business generated data could be shared: how old the data is and whether it contains PII. Data that is one or two years old could be shared more freely as it has limited value for the companies. However, newer data must not be shared with competitors. Non-disclosure agreements and a secure data management system would most likely be necessary for access to this type of data.
- Access strategy should ensure PII data storage and use are in line with the GDPR. Data containing PII will be the most difficult to access and will require special terms and conditions for use. Moreover, PII will be covered in the new data protection legislation that is due to be implemented in one to two years' time. This legislation, called GDPR (see WP8 D8.3), will potentially be a major obstacle to data sharing between companies and the RI. However, it is unknown at this moment what the impact of GDPR will be.

RI rules for data ownership, privacy and IPR

Duration of data storage

The retail case study in WP8 D8.1 revealed a potentially important problem in terms of limited allowed storage of business generated consumer data, which, in the case of Swedish law, is limited to eighteen months. This may be different in other EU countries and it will be important to investigate limitations on time frame for data storage and usage for scientific research. The issue illustrates a potential cross-country legislation problem that has to be solved in relation to the RI.

- The time-frame for business data storage needs to be harmonized through a joint legislation procedure within the RI.

Consumer privacy issues

If the scientific case considers a detailed analysis involving tracking of single individuals, the proposed RI may have a legislation problem. As illustrated by the retail case study of WP8 D8.1, the retailer cannot share their consumer ID loyalty data with other partners in Sweden, and similar problems may therefore be expected to occur on the EU level.

- Thus, an EU-legislation for intra-EU consumer identification may potentially be needed to solve such issues.
- Further, the allowed time frame to store consumer data with respect to consumer privacy needs to be taken into account.
- Consumer privacy legislation concerning identification of consumers and storage of associated data needs to be considered in relation to the RI.

Data access permission

As can be concluded from the four case studies in WP8 D8.1, there are significant differences in how the RI can access the provided data. In the public procurement company case study, data access is only granted people within the organization, which in turn can provide the necessary data. Similarly, for the market organization case study, the data is extracted from their platform, once an agreement on terms and conditions has been signed. For the statistical institution case study, data access requires affiliation with an authorized national institution which can assume the overall responsibility. Without an overall legislation around simplification of data sharing with EU-level research institutions, it may thus be expected that;

- The RI may have to negotiate terms and conditions for data sharing with the different data providers in the different countries.
- The RI needs an overall EU legislation around data sharing with EU-level research institutions in order to avoid having to negotiate terms and conditions with different data providers in different countries.

Access agreement

A key issue with respect to data sharing terms and conditions agreement that could be identified through the statistical institution case study in WP8 D8.1 is careful handling of non-aggregated data in order to avoid possible identification of an associated enterprise. Similarly, the retail case study also emphasized this concern due to stock market exposure and since sensitive information on company performance can be used for non-legal money making purposes. Data access in specific projects thus has to be discussed with the retailer. It is however more likely that retail organizations can share partial data with the RI, since this was considered less of an issue. A similar situation was also identified in the market organization case study, where e.g. a retail business may acquire information from market organizations that can be used to attract competitors' customers. The statistical institution case study also acknowledges problems with sensitive information, e.g. business turnover, which in Denmark is protected by law.

- Thus, the proposed RI is likely to require specific EU policies on data handling, data aggregation and disclosure to meet the concerns of data providers.
- The RI needs specific EU policies on data handling, data aggregation and disclosure to handle non-aggregated data which allows identification of companies and their associated customer base.

Access privacy issues

Regarding access privacy issues it is interesting to note differences between the case studies in WP8 D8.1. The public procurement company sees no privacy issues related to the statistics/data and access by e.g. researchers is neither subject to any confidentiality or ethical constraints. On the other hand, the market organization guarantees that household panelist personal information will be protected by the Danish law. Thus, the organization may not be able to disclose the full details of the household panelist to the proposed RI, unless given active consent from each individual household. It seems like further EU legislation may be needed in this matter.

- The extent of the data privacy issue will likely depend upon specific data provider, provided data and country legislation and may be simplified through EU legislation.

Key governance issues

The input from the stakeholder workshop in WP8 D8.3 was able to further concretize privacy and ethical concerns adding to the information obtained in WP8 D8.1. The main points were:

- The GDPR might set the framework for data governance within the RI. This legislation does not only apply to companies but to all types of organizations that collect, store or process PII data.
- Development of governance for data sharing would benefit from a demo-case study. The governance and ethics discussion would be easier if at least some parts of the RI business model were already in place, as data governance and ICT structure is directly linked to the business model.
- Ethical issues are mainly linked to PII data and the risk that this data could be used for commercial or harmful purposes.
- There are also ethical issues regarding consent for data use. Consumers might not be aware that they are consenting to their data being used by the RI when applying for a loyalty card, for instance.

A unique feature of the RI could be to provide access to anonymized data on an individual level. This feature invokes a number of key issues in governance:

- Governance: **Legal issues.** The project consortium could take a closer look at Science Commons (see WP8 D8.3) as an inspiration when designing the governance model, and to GDPR regarding PII-data.

- Governance: **Data collected by businesses**. Identifying who is permitted to make **decisions on data sharing** within a business organization should be done early in the process of discussing data sharing with businesses.
- Governance: **PII-data, anonymized data and ecological data**. The platform could only handle aggregated data in order to avoid legal and ethical issues. Care needs to be taken even when linking aggregated data from different sources that could potentially lead to identifying an individual. This statement is however in contrast to the RI offering anonymized data on an individual level as a unique feature.

Business models for a research infrastructure.

The governance of a research infrastructure is closely related to how different stakeholders in the consumer behavior and foresight business perceives the idea of sharing different datasets for the mutual benefit of a broader range of stakeholders including the research community. The WP8 case studies also provides some insight into the perceptions of difference kinds of users of consumer behavior and foresight data. Given the fact that such stakeholders already holds experience on how a more permanent data platform should be organized their views on how to organize it as a business is valuable. That include for instance how the undertaking could generate income and how a pricing strategy could be laid out.

Need for different business models

The retail case study in WP8 D8.1 could conclude that research is likely to be appreciated among retailers in terms of looking for opportunities to increase the quality and output from their data analysis. Such activities may be facilitated by a close collaboration with the proposed RI in joint consumer behavior and health related research. In contrast however, the market organization case study showed that health issues may be considered to be the researchers' responsibility, and data is also sold to research universities, but at the same time shared for research purposes at the EU level.

- Thus, the proposed RI may need to conceive of different business models in these different cases.
- The RI may need to consider different business models, e.g. direct payment for used data, with different data providers, where the mutual benefit aspect must be taken into account.

Data sharing benefits

The research in WP8 identified a variety of users for the generated data across the cases. In the public procurement company and statistical institution case studies, the stakeholders range from journalists, interest groups, authorities to research institutions. As potential data providers to the current platform, it may thus be expected that the same stakeholders will be interested in the activities of the proposed RI. On the other hand, in contrast to the retail and market organization case studies, public procurement companies and statistical institutions seem more likely to engaging by freely sharing their data with the proposed RI. In the statistical institution case study it was also expressed that the possible interaction with the RI can generate new

insights on how the data can be used to address societal health issues and thus work more pro-actively to support the researchers' needs. Thus, different data providers may be more likely to share their data freely with the RI.

Potential data sharing barriers

A key point from the WP8 case studies is that business organizations will be more reluctant to share the generated data on RI than the public institutions knowing that other organizations, e.g. retailers, could potentially benefit from such data while not sharing their own data. As both a data provider and potential data user, it is interesting to look at how business and retail organizations may interact with the proposed RI. The WP8 D8.1 retail case study shows that retailers are dependent on business generated consumer data in order to optimize their market performance, but they also buy complementary market data on competitors' performance, as well as selling it to suppliers and organizations. Retailers also seem willing to share data with universities for mutual benefit purposes. If the RI does not want to buy data from retailers, the mutual benefit aspect is something that the proposed RI needs to consider.

- It is important that the RI can add another dimension to the provided data than the companies can already do themselves. This can be done by e.g. sharing more complete joint data sets in exchange for company-generated data.
- In addition, best practices will be to develop strategies that could help exclude entities and businesses organizations likely to have competitive urge over their counterparts in sharing data on the RI to further the course of researchers' effort to address societal challenges. This can be considered in terms of paying for any data they use or allowing for use of data that may not have competitive advantages.
- The RI may have difficulties in obtaining and handling complete data sets that contain sensitive information in terms of tracing companies' or competitors' performance.

5. Conclusion

This final recommendation report of the WP8, was prepared from research findings reported in the three separate deliverables of the work package, D.8.1, D.8.2, D.8.3 and stakeholder feedback from Nordic workshop. The report provides recommendations relating IC technology, governance and business model of RI needed to feed into Phase 3 (WP 13). The recommendations are considered relevant for the Phase 3, which has responsibility of collating and finalizing the overall recommendations from the other WPs in the project to design the RICHFIELDS infrastructure.

Appendix 1. Table 2. Review of ICT used by retail and market research organizations.

Sector	Type of technology	Data capturing technology	Devices facilitating data capture	Type of data collected	Case studies
Retail	Consumer location sensing technologies	Geo-fencing	Smartphones, GPS-devices	Location data involving a location-sensitive device (eg. smartphones with GPS)	RetailNext (Aurora, Mobile Engage), Euclid (Traffic, Insight), Shopkick (shopBeacon), Brickstream (Brickstream 3D+), Axper (3D vision, Sentinel), PathTracker
		Wi-Fi	Smartphones, tablets	Location data of smartphones connected to Wi-Fi	
		Bluetooth Low Energy (BLE)	iBeacon-compatible transmitters, smartphones	Proximity data to Bluetooth beacons of enabled smartphones	
		Visual systems	Analog or IP cameras, infrared cameras	Visual tracking data	
		RFID Technology	Smartphone RFID reader, RFID sensors	Consumer real-time product choice and purchasing data. Aggregated shopper tracking data to determine shopping speed, purchasing speed, and geography of trips.	
		Combination of technologies mentioned above	Several sensors available that combines different data capturing technologies. E.g., Aurora from Retailnext combines video technology with BLE and WIFI.		
	e-commerce and mCommerce	Online analytic tools for personal computers	Smartphone, personal computer, tablet	Web browsing patterns and online shopping patterns (Cookie data), online purchasing data	Adobe marketing cloud (Adobe), Virtual stores (Walmart)
		Online analytic tools for mobile devices	smartphone, personal computer, tablet	Mobile phone data	
	Social media			Social media sentiment analysis data	Kellogg's tweet shop
	Point of sale technologies	Barcode Technology	Digital barcode scanner, Smartphone barcode app (mobile point of sale), self-service checkouts, tablets, NFC tags	Consumer grocery shopping data	GfK ConsumerScan "Mini-Danmark, Mobile Point-of-Sale (SCANDIT), NFC tags in Casino supermarkets (France)
		Other point of sale hardware	Payment terminals, weighing sensors, cash registers	Amount owned, weight, money transactions	

		Cloud based Point-of-sale software	uses data from devices mentioned in barcode technology and other point of sale hardware		Epos Now, Lightspeed Retail, Revel Systems, Lavu iPad POS
		Traditional point of sale software	uses data from devices mentioned in barcode technology and other point of sale hardware (except smartphone barcode scanners)		AIMsi, AmberPOS, RetailSTAR
Market Research Organization	Automated Voice Response and Voice Recognition	Interactive Voice Response survey	Touchscreen, freephone, post-call transfer to survey line, computer aided telephone interviews, web, email and SMS	Consumer feedback on product purchased and used	Vision OneTotalRecall
	Digital Observation and video	Digital diary and video recording	Webcam, smartphone, tablets, video camera, or some other type of digital audio/video recording device.	Consumer can either speak into the camera to describe a situation or feeling, or can take us on a tour, so to speak.	Olinger digital video diary
	Geo-location	GPS technology	Smart phone using apps with image, video capturing and survey questionnaire and integrated location	Photograph and record in-the-moment data in a specific location.	SSI's mobile QuickThoughts® 2.0 app. Geo-Intercepts app with features such as: GeoValidation, GeoIntensity and GeoNotification®.
	Neuromarketing research	Neuromarketing Techniques	Smart phone, tablet and laptops using facial recognition and other neuro analytics software	Captures the expressions and emotions people exhibited towards using a product	Face Reader-Noldus IREACT and Eye tracking-One vision

Table 2. Review of ICT used by retail and market research organizations.

Appendix 2 Agenda for Richfields Multi-Stakeholder Workshop on Big Food Data, March 1st, 2017

Can we understand consumer behaviour through digital traces of food purchasing

Richfields Multi-Stakeholder
Workshop on Big Food Data

Venue:

GS1 Denmark, Vesterbrogade 149,

 DK-1620 København V Copenhagen,

March 1, 2017, 9.30-15.30

The purpose of the Richfield workshop is to present on the first findings from the study on business-generated data in the Richfield Workpackage 8. We have analysed 2 Danish and 2 Swedish business cases. Against this background we want to invite for a discussion on how important groups of data users can take advantage of an open and shared European research infrastructure that will have the potential to assist a broad range of societal stakeholders to better understand consumer behaviour through digital traces of food purchasing.

Morning session 1. What we learnt so far in RF WP8

9.30. Registration

9.45 – 10.00. Welcome: Richfields – why the EU is interested in our digital food shopping patterns?, Bent Egberg Mikkelsen, Aalborg University

10.00 – 10.30. Business generated data - will data owners share their data with researchers? Results from Danish RF interviews, Kwabena Ofei AAU, Haris Hondo SP/RISE & Erik Kaunisto, SP/RISE

10.30 – 10.50. Lab generated data – what kind of data can be collected in smart food labs? Sophie Hieke. DL Germany.

10.50. Break

11.10. Morning session 2. Potentials of Big Food Data as seen from the business community

11.10 – 11.25. Big food data - What the app developers want. Kamil Dabrowski, Founder & CEO, Foopla, Denmark

11.25 – 11.40. Linking patterns of food choice to nutrients via TradeSync, Sacha Mendes da Silva, GS1 Denmark

11.40- 12.30. Lunch

12.30 – 12.50. Can shared data compete with commercial data? Joel Ringbo. Data Analyst ICA AB, Sweden

12.50 – 13.05. What kind of future data sharing do retailers anticipate? Erhard Nielsen, Chief Developer, COOP consumer insight, Denmark
13.05-13.25 Break

13.30 Interactive World Café (WFC)

How should a future infrastructure look like? The WFC is divided in three groups: 1. Apps developers, 2. Market intelligence, 3. Research and 4. Public Health. The WFC takes 4*20 minutes. Each of the 4 groups are assigned 1 moderator and 1 note take – both permanent. The other participants are asked to stay 20 minutes in each group and then circulate to the next. The WFC will contain four interactive sessions where attendees will be encouraged to share ideas and opinions:

Activity	Theme/RI relevance	Questions to be discussed
Activity 1	**Scientific potential** Moderated by Bent E Mikkelsen. Note taker: Michelle Steenvorden	a. How would a potential Richfields platform help address your specific research needs (e.g. questions it will help answer)? b. What do you see as the benefits of sharing your data with the research community, e.g. via the RICHFIELDS platform? c. What general/long-term impact would/could such a platform have on you? d. How do you think such a platform (data sharing) should be communicated, both to manufacturers and researchers?
Activity 2	**User strategy** Moderated by Kwabena Ofei. Note taker: Sophie Hieke	a. Would you want to be a potential future user of the RICHFIELDS platform? b. What kind of a relationship would you expect with such a platform? (e.g., from a minimum model only providing data to a maximum model with different access rights to the data) c. What benefits do you expect for collaborating with the potential Richfields platform. •As a data user (customer) of the Richfields platform

		d. What risks/barriers do you anticipate in collaborating with the potential Richfields platform?
Activity 3	**Access strategy** Moderated by Haris Hondo Note taker: Sacha Mendes da Silva	a. To what extent would you be willing to collaborate/share data with the proposed Richfields platform that may be offer extended access to users outside the research community/academia? b. what factors should be considered to formulate data access policy for RI? c. Why are they important?
Activity 4	**Governance and ethics** Moderated by Erik Kaunisto. Notetaker: Tue Christensen	a. Do you foresee legal or ethical (e.g. data sharing, consent) issues in sharing your data with RICHFIELDS? b.What recommendations would you make for the design of the proposed Richfields platform to add value to their activities/best meet their future needs in terms of •data governance, •organisational governance (business models) •ICT organisation?

14.45 After the WFC the results from each are presented in plenary by the moderator from each group.

Workshop Outcome

A report containing all the key findings and main conclusions will be prepared as a Deliverable of work package 8, D8.3

Workshop follow-up

The follow-up of the workshop will include an e-mail to participants thanking them for their attendances. In addition, they will be provided with a link to the workshop's agenda, including speaker's presentations, and summarize report on the workshop findings

15.15 Closing remarks

Appendix 3 Minutes from the Nordic stakeholder meeting. October 3, 2017

"Advancing food and health research in Europe - building a research infrastructure on food related to nutrition and health. Nordic Stakeholder Workshop on how Research Infrastructures for Big Food Data can help get us on the road to world class insight in consumer food practices"

The meeting was held at Lund University, Lund Campus October 3rd, 2017 and was arranged by Aalborg, Lund and Wageningen Universities in cooperation with RISE, Sweden.

The target group was key actor in the food sector in Nordic countries and the meeting was a follow up on the previous stakeholder meeting held at GS1 in march 2017. Part of the aim was to collect feedback from stakeholders in the Nordics on some of the findings from the Danish/Swedish case studies so far and to discuss the potentials of a future permanent data and research infrastructure. The meeting aimed at discussing how a research infrastructure could add value for a broad range of stakeholders in the Nordic and European food sector. The idea was to invite stakeholders to discuss and share their views with the researchers on how a better and more vigilant and real-time understanding of consumer food practices could be created through the sharing of data from a wide range of digital media sources. The Nordic Stakeholder meeting was planned in order to give participants the possibility to discuss how vigilance in this area might assist the Nordic countries to get on European roadmap for future research infrastructures in the food, nutrition and health area. Meeting organizers were Bent Egberg Mikkelsen, AAU; Leif Lundin, RISE; Yvonne Granfeldt, LU and Karin Zimmermann, WUR. The meeting was moderated by Bent Egberg Mikkelsen. The notes from the meeting were taken by RF team members Mukti Chapagain, Yulia Popova and Shova Acharya Dengal. The program is enclosed as appendix 1 and the presentations can be found in appendix 2. Participants are listed in appendix 3.

The participants was welcomed to Lund University with opening remarks from Yvonne Granfeldt, director of LTH food. A brief introduction to the food research at Lund University was given as well as an introduction to the new accelerator research infrastructure being built at the campus in cooperation between Denmark and Sweden and with the support of a number of other European countries.

An introduction to some of the driving forces behind the increasing policy interest in research infrastructures was given by Bent Egberg Mikkelsen, Aalborg University in a talk entitled *Interconnectivity & digitalisation as a new paradigm for food, nutrition & health research area.* The talk presented a brief overview of some significant cases of research infrastructure initiatives and underlined the need to cater for both the soft – and hardware parts of research infrastructures. That is that RI's should accommodate both data sets and at the same time facilitate a closer cooperation between the labs in the European arena that are studying food behaviour in experimental settings and using smart sensors for data collection. A brief overview of the three study cases in the Richfields design study was given: the Aalborg University Foodscape Lab, the Restaurant of the future in Wageningen and the Fake Food Buffet lab at ETH in Zürich.

Karin Zimmermann, Wageningen University and Research and PI of the Richfields introduced the idea of the *Food, Nutrition and Health Research Infrastructure – the FNH-RI* and gave an account of what kind of research questions might be answered using big food data in this type of infrastructure.

After a break, three business cases were presented. Erhard Nielsen, chief data analyst, Dagrofa Denmark explained how the company are making sense of big food data. In his lecture he spoke about the potentials of using loyalty card data from consumers and underlined the need for taking a close look at the General Data Protection Regulation (GDPR).

Bringing insight in form the "non food" area – the digital expertise is a crucial point in the discussion of research infrastructures. Mats Eliasson, responsible for Digital Strategies at Stanford Research Strategies gave a presentation answering some of the questions related to "the digital. His presentation was entitled *How Big food data analytics can assist food sector.*

Eric-Alan Rapp, CEO and founder of Homemate Aps then gave a presentation on how a new start up omni-channel retailer like Homemate anticipating to be using Big Foosd data. The talk was entitled *Slicing and dicing – finding structure and mining the data of Omni channel food retailer - case insights from a case study.*

The European efforts on creating an international Research Infrastructure is in many cases reflected by national efforts. That is also the case in Denmark. In her talk Michelle Williams, AU Food, Aarhus University introduced the Danish case of a strategy to create national funds to accompany the RoadMapping. The presentation title was *The FoodHay – food on the road map for Danish Research Infrastructures.*

Visualizing data about consumer behavioral and movement is an important component of Big Food Date analytics. In his talk Samo Olsen, CEO, Mapicture Picture this –a multi-source data predictive model to plan future foodscapes gave an account on the potentials in visualizing data on maps as well as the potentials of linking different sources of real-time online data simultaneously.

Hua Lu; Associate professor from AAU then gave a presentation on how digital patterns create by users of Social Media can potential provide important information on food behavior. The presentation was entitled *Can we use Social Media activity to make sense of food behavior.*

The interactive part of the day was introduced by Bent Egberg Mikkelsen that pointed to the fact that having 30 participants from all over the Nordic countries represented offered a unique opportunity for trying to reach some kind of common understanding of the need for research infrastructures in the food area. And that the discussion at the same time aimed at giving recommendations for the design of the FNH infrastructure.

The participants had in advance received a summary of the findings from Richfields workpackage 8 thematically organised around: best practices of data collection, ICT used for data collection and stakeholder demands and views. Kwabena Ofei briefly introduced the conclusion from the three WP8 deliverable corresponding to the 3 themes under the presentation title *Introduction to Richfield findings – best practices of data collection, data collection technologies and stakeholder views.*

Participants in the plenary was invited to share their views on what kind of constraints they would anticipate for a "food RI" for instance problems and barriers and what potential could be foreseen for an "food RI" for instance what kind of strengths & opportunities. A slight change of programme was made by the end of the day. The group based discussion was instead carried out as a plenary discussion.

There was a general consensus on the fact that the preparation of a future research infrastructure would benefit from a closer Nordic cooperation since the culture and structure of research system is quite similar. It was generally agreed that the digital nature of a research infrastructure make it imperative to look deep into the rules of data protection rules and routines and that inspiration and guidance could be found in the GDPR. Also the need for training of future users at more levels of the educational system was touched upon. The business model for running a permanent research infrastructure was discussed and the importance of getting support from the national research support systems was underlined. That includes both getting food, nutrition & health on the national roadmaps of each country as well as preparing for getting financial support in each country to support the activities. The discussion also showed that there is a general interest in building capacities around the borderline between "food" and "the digital". For instance Block Chain Technology, internet of food things and cognitive computing was mentioned as examples of areas where close cooperation between the different kinds of expertise would be essential.

The discussion then briefly touched on the possible governance structure of a possible research infrastructure. It was generally agreed that it was important to have a broad range of stakeholders supporting the idea, not only academia in the food area but also other kinds of potential future data users such as industry, retail, government food agencies and market intelligence bureaus.

The discussion on the potential benefits included a part dealing with the soft and the hard parts of a research infrastructure. It was mentioned that such infrastructure should pay attention to hardware part that is linked to the physical installations – the food labs that is a part of the RF study and that cooperation and sharing of devices, sensors, protocols and equipment is an important part of the as well as the sharing and cooperation of the soft part (data) is facilitated?

Appendix 4. Program

Advancing food and health research in Europe - building a research infrastructure on food related to nutrition and health

Nordic Stakeholder Workshop on how Research Infrastructures for Big Food
Data can help get us on the road to world class insight in consumer food practices

Venue: Lund University, Lund Campus
October 3rd, 2017 | 9.30 - 16.00

Making sense of ever increasing amount of real time and digitally created data is one of society's important challenges. Its important for food system that is vigilant and ready to act fast on hazards and risks in the food sector and its important for science to be able to answer emerging research questions. The private sector, the 3rd sector and government as well as intra-governmental entities will obviously be able to benefit as well. The European RF design study is an attempt to address some of the most important challenges for a future globalized, well-connected and digitalized food sector. It proposes a design for a new vigilant research infrastructure in the food, nutrition and health area.

RF partners in the Øresund area therefore invite Nordic stakeholders to discuss insights so far from the RF study and to discuss how a future European research infrastructure can be created in a way that will add value for a broad range of stakeholders in the Nordic and European food sector, We invite key actor to discuss and share their views with us on how a better and more vigilant and real-time understanding of consumer food practices can be created through the sharing of data from a wide range of digital media sources.

Bent Egberg Mikkelsen   Leif Lundin   Yvonne Granfeldt   Karin Zimmermann

Program

<u>**09:30 – 10:00 - Registration, coffee and light breakfast**</u>

- Welcome to Lunds University, opening remarks from Yvonne Granfeldt, director of LTH food.
- Interconnectivity & digitalisation as a new paradigm for food, nutrition & health research area. A brief overview of significant cases and ongoing research infrastructure initiatives. Bent Egberg Mikkelsen, Aalborg University
- What research questions can be answered with big food data embedded in a Food, Nutrition and Health Research Infrastructure? Presentation about the FNH-RI science case, Karin Zimmermann, Wageningen University and Research

<u>**11:15 – 11:35 - Coffee break**</u>

- Making sense of big food data - Erhard Nielsen, chief data analyst, Dagrofa Denmark
- How Big food data analytics can assist food sector, Mats Eliasson, Digital Strategies Stanford Research Strategies
- Slicing and dicing – finding structure and mining the data of Omni channel food retailer - case insights from a case study. Eric-Alan Rapp, CEO and founder of Homemate Aps,

- <u>**12:35 – 13:30 – Lunch**</u>

- The FoodHay – food on the road map for Danish Research Infrastructures, Michelle Williams, AU Food, Aarhus University
- Picture this –a multi-source data predictive model to plan future foodscapes. Samo Olsen, CEO, Mapicture
- Can we use Social Media activity to make sense of food behavior. Hua Lu; Assoc Prof AAU

14:15-15.30 Have a coffee & Share your views. What should be in it for me?

- Introduction to Richfield findings – best practices of data collection, data collection technologies and stakeholder views. Kwabena Ofei.
- Practicalities of the break outs. Bent Egberg Mikkelsen

Each of the three sessions will be guided by a summary of Richfields findings. Groups will be selected by organisers. Sessions are aimed at giving recommendations for the design of the FNH infrastructure. Each group will discuss the following 5 questions.

1. What constraints can you anticipate for a "food RI"? Problems and barriers.

2. What potential can you foresee for an "food RI"? Strengths & opportunities

3. Governance of a research infrastructure. Who decide what?, which stakeholders should be involved in running the RI, which stakeholders needs to be involved in the governance? which privacy issues are important to take into account?

4. Business model of a research infrastructure. How could the RI make money? Who should be paying for using the structure? How do we makes sure that both the hardware (cooperation and sharing of devices, sensors, protocols and equipment) as well as the sharing and cooperation of the soft part (data) is facilitated?

5. ICT and the research infrastructure: How do we integrate different data sets and secure seamlessness, what computer power is needed? Can Block Chain Technology be utilized, how do we take maintenance and data management into account and what about access?

<u>**Groups**</u>

1. Group Bizz Moderator: Haris Hondo. Notetaker: Mukti Chapagain
2. Group ICT Moderator Bent Egberg Mikkelsen. Notetaker: Yulia Popova
3. Group Food Science. Kwabena Ofei. Note taker: Shova Acharya Dengal

- The results from each are presented in plenary by the moderator from each group. Wrap up presentation to conclude on user needs and feasibility in Nordic countries and the roadmap to proceed for the next steps, Moderated by Karin Zimmermann and Bent Egberg Mikkelsen

- Closing remarks – what are the next steps towards a future research infrastructure?

Appendix 5. Presentations

- [Welcome to Lunds University & opening remarks.](#) Yvonne Granfeldt, director of LTH food.
- [Interconnectivity & digitalisation as a new paradigm for food, nutrition & health research area. A brief overview of significant cases and ongoing research infrastructure initiatives](#). Bent Egberg Mikkelsen, Aalborg University
- [What research questions can be answered with big food data embedded in a Food, Nutrition and Health Research Infrastructure? Presentation about the FNH-RI science case](#), Karin Zimmermann, Wageningen University and Research
- [Making sense of big food data](#) - Erhard Nielsen, chief data analyst, Dagrofa Denmark
- [How Big food data analytics can assist food sector](#), Mats Eliasson, Digital Strategies Stanford Research Strategies
- [Slicing and dicing – finding structure and mining the data of Omni channel food retailer - case insights from a case study](#). Eric-Alan Rapp, CEO and founder of Homemate Aps,
- [The FoodHay – food on the road map for Danish Research Infrastructures](#), Michelle Williams, AU Food, Aarhus University
- [Picture this – a multi-source data predictive model to plan future foodscapes.](#) Samo Olsen, CEO, Mapicture
- [Can we use Social Media activity to make sense of food behavior](#). Hua Lu; Assoc Prof AAU
- [Introduction to Richfield findings – best practices of data collection, data collection technologies and stakeholder views.](#) Kwabena Ofei.AAU

Appendix 6. Participants List

NAME	PLACE
Alsted, Martin	FOODJOB
Berget, Ingunn	Nofima
Bergsteen, Jenny	Food Nexus
Burleigh, Stephen	Food-health-science.lu.se
Champagain, Mukti	AAU Food
Davies, Jennifer	RISE
Dengal, Shova	AAU
Dyrholm, Heidy	Food Nexus
Eliasson, Mats	Stanford Research Insitute
Granfeldt, Yvonne	Lund University
Hondo, Haris	RISE
Hua, Lu	AAU computer science
Jevinger, Åse	Malmö University
Jonsson, Håkan	Lund University
Kugelberg, Susanna	WHO CPH
Lien, Nanna	The Medical Faculty
Mikkelsen, Bent Egberg	DCM/ AAU
Nairi, Khadija	WECR
Nielsen, Erhard	Dagrofa
Nordgren, Lars	Lunds University
Ofei, Kwabena	AAU food
Olsen, Samo	Mapicture
Popova, Yulia	IT university
Rapp, Eric Alan	Homemate
Rautiainen, Teija	XAMK University
Rinnan, Asmund	KU food
Rydberg, Anna	RISE
Williams, Michelle	Aarhus University
Zimmermann, Karin	WECR
Åsmund, Rinnan	KU food