AuroraAI – Towards a human-centric society

Development and implementation plan 2019–2023 based on the preliminary study on the Aurora national artificial intelligence programme

Foreword

The Ministry of Finance set a preliminary study project on the Aurora national artificial intelligence programme for the period 15 September 2018 – 28 February 2019. The aim of the study was to identify what kind of changes a human-centric and life-events-based approach would entail in terms of, inter alia, the provision and management of services. In addition, the project produced a concept and a trial version of the AuroraAI network that enables interaction between the smart services of organisations that provide services for people's life events. For the consumers of these services, the aim of Aurora is to facilitate seamless and smoothly functioning service paths in different life situations and for different life events, where these paths comprise many different service providers' services. The ways in which these aims would be put into effect were examined during the course of the preliminary study project based on life-event pilots launched in spring 2018.

The preliminary study project is part of the proposals made in the Finland's Age of Artificial Intelligence report. The report describes how Finland benefits from beginning the application of artificial intelligence as early as possible. According to a report estimate, if active artificial intelligence-based development measures are focused on new development and generating growth, the per capita GDP would increase 3% a year until 2030 and net employment would be as much as 5% higher.

The AuroraAI development and implementation plan 2019–2023 is a joint vision of the preliminary study project and its network partners on how the transitioning of Finland, and in particular its public administration, should be accelerated in the coming years in a secure and ethical manner. This document is the result of the work of hundreds of people from across all sectors. Contributors included municipalities, provinces, the third sector, businesses, government agencies and ministries. The background and conclusions of the document are based on numerous studies, pilot projects and preparatory inquiries, which are being carried out with great energy around the country. This proposal could not have been produced by one organisation alone. The open network-based approach has enabled the contribution of a range of ideas and viewpoints, which have enriched the end result in a way that could not have been predicted. This same approach of open and collaborative teamwork will ensure Finland's competitiveness in the future.

The work would not have been possible without the contributions of all the people who have given their perspectives from different sectors of society. The work has only just started, and we hope that many more people will get involved in the future. We are building a human-centric society in the age of artificial intelligence, and you are invited!

March 2019

Aleksi Kopponen
Ministry of Finance

Niko Ruostetsaari
Ministry of Finance

AuroraAI partner network

The AuroraAI project is a broad-based and open stakeholder process implemented through the Public-Private-People-Partnership (PPPP) approach. Systemic change is not possible without cross-sectoral cooperation. At the time of writing, the AuroraAI network has more than 330 members. For the preliminary study phase, the work was divided into packages, which were prepared by the following personnel and network partners (in alphabetical order):

AuroraAI coordination (Ministry of Finance):

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Ruostetsaari Niko, Coordinator, Ministry of Finance
Salonen Jouko, Senior Specialist, Ministry of Finance (until 31 December 2018)

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Work package 2: Gaining a foothold in working life through competence development

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Silfver Vesa, Consulting Lead. Vdovenko Konstantin, Managing Director. Sysi-Aho Marko, Data Science Manager, Accenture Oy (health and public service consulting).
Implementation of the trial solution:
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and Haavisto Jami and Tuomela Petri, Suomen Tilaajavastuu Oy
Study on identity management in lifelong learning: Miettinen Manne, Honko Harri, Kohtanen Jukka, CSC

In addition, development was assisted by students, learning and employment ecosystem operators from a number of sectors, and the AuroraAI developer community.

Work package 3: The well-being of children and parents in changing family relationships

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Work package 5: Ethical code
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In addition, the following persons have made a significant contribution to the AuroraAI project and the formulation of a concept for a human-centric and proactive society:

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Abstract

A human-centric society is based on the holistic welfare of its people, businesses and society as a whole. The human-centric approach materialises through life-event-based thinking, which informs service design and provision and enables people to support their own welfare and that of their loved ones through various life stages. There is a need to make services more effective and better-targeted at people's real needs and to put an end to the way people are passed between agencies in order to enable people to manage their lives more easily. The AuroraAI preliminary study project proposes the launch of an implementation programme for the development of a human-centric society in the context of selected life-events and business activities. The implementation programme would improve the effectiveness of services, simplify current service chains and promote the use of data in service provision. Service allocation and proactive referral would be based on the AuroraAI network, which enables interaction between smart and AI solutions in a secure and ethical manner that serves the needs of citizens and businesses.

In the first stage of the implementation, key life-events and business activities are identified in cooperation with citizens and businesses. Service ecosystems will be created around the selected events based on open collaboration.

The implementation will be supported by a change support team and a public response centre. The team supports organisations that are in the process of implementing changes, develops a management-by-information model based on data about service users' needs provided by AI, and formulates a playbook and guidelines in cooperation with the organisations implementing the change. The agreed rules can cover e.g. different actors' responsibilities, roles, the application of law and the uses of technology in the model.

AuroraAI will improve our ability to resolve major challenges of our time, such as the sustainability gap in public finances, an ageing population, and the marginalisation of young people. All this can be done by formulating cross-sectoral situational data on people's real needs and current welfare status. Situational data requires new ways of leveraging data as well as new data analytics methods and other AI solutions. At the same time, services can be allocated more economically, and resource waste and underuse can be reduced.

AuroraAI provides people with a new way to manage their holistic welfare and to access well-functioning, effective and timely services during various life-events and situations. It enables service providers to create customer-focused and dynamic service chains in cooperation with other providers and manage their operations dynamically based on real-time data. Management-by-information in organisations would be improved.

The next government has a unique opportunity to transition Finland towards the AI age in a human-centric, secure and ethical way.

Glossary

Concept	Definition
AuroraAI	A concept for human-centric and ethical society in the age of artificial intelligence
AuroraAI service model	A service model for creating a human-centric service market around a selected life-event or business activity.
AuroraAI network	A decentralised open network of smart services and applications
AuroraAI partner network	Group of providers whose services and applications are connected to the Aurora network
Situational awareness	A data-based model of describing statuses, attributes, trends and system dynamics relating to customers or the analysed phenomenon in sufficiently realistic detail to enable its use in customer/phenomenon-focused management.
Situational management	An approach which is based on the use of a holistic model describing the target group or phenomenon; used in co-management through consensus formation.

Human-centric approach leads to fundamental change

Technological advances happen ever more rapidly, and the revolution brings with it new opportunities and risks. Societal structures must adapt to the change in a way that enables us to benefit from the opportunities while managing the risks. In the coming years and decades, Finland will face major challenges such as ageing populations and high rates of structural unemployment. So-called 'wicked', deeply intertwined problems cannot be resolved without more systematic efforts to harness the opportunities offered by technological advances and digitalisation to promote citizens' welfare. On the other hand, the deterioration of the dependency ratio, the growing sustainability gap in public finances, growing demand and evolving needs mean that service offerings must be developed in a more agile way than currently is the case, services must be matched better, and customer-focused service systems must be managed more effectively and proactively. The technological revolution provides new tools for building a human-centric society.

Rapidly evolving technologies offer organisations better opportunities to regenerate their operations, deliver savings and improve the availability, quality and customer experience of their services. These modern, digital transformations in the service structure can offer citizens more convenient access to services while saving time and costs. However, a truly digital society is more than that. It is about creating new, human-centric service systems in a way that is cross-sectoral and departs from existing practices through broad-based cooperation involving the public, private and third sectors. It transforms the whole service system and thus generates new value for all stakeholders.

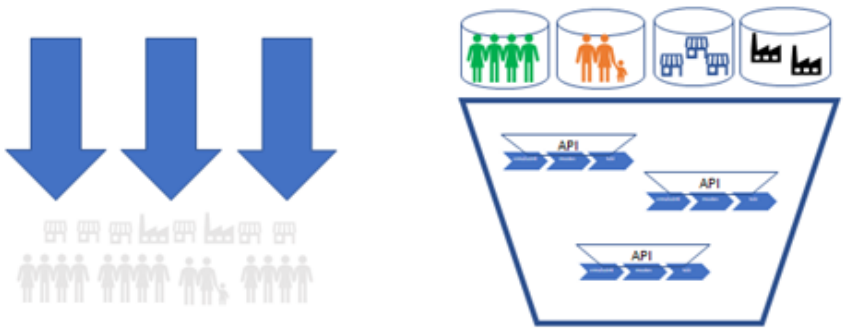

Figure 1. From managing services to managing customer-focused service markets

This value creation is only possible in ecosystems that enable interaction between service providers, citizens and public sector organisations in an organic and open way. Compatible, open ecosystems increase the volume of digital services and facilitate the development of new products and businesses. True digitalisation ultimately happens through interaction, not as a

result of an individual operator's actions. Finland's competitiveness in the global stage comes from our trust-based, open society and cross-sectoral cooperation. Conventional sector-specific projects, which are often far removed from citizens' everyday lives in terms of their goals and practical implementation, can easily lead to overlap and inefficiency in procedures and aims. In the future, co-development and cooperation with the private and third sectors as well as with citizens should be based on new types of models that are centred around life-events and business activities. Cooperation across sectoral boundaries provides a basis for joint commitment to difficult changes and reforms.

Transitioning from the current production-led model towards a human-centric model will require a number of significant changes. People will have access to better personalised services that are based on both personal data (MyData) and population-level data, as service ecosystems utilise AI solutions to develop completely new types of services that are matched to people's personal life circumstances and the needs of businesses. The operations of ecosystems and organisations cannot be sustainable unless they, in exchange for access to data, produce value for citizens and businesses and safeguard citizens' trust in the ethical use of data.

On the other hand, in a human-centric society, the operators of a service ecosystem have opportunities to develop customer-focused service management practices, provided that citizens and organisations allow the operators to collate customer data from different sectors to generate a more comprehensive overview of factors associated with welfare. For public sector organisations, the data collected by the service ecosystem provides an improved understanding of the real-world impact of existing services. This information can be used to steer the operators to develop services that promote citizens' well-being and the prosperity of businesses.

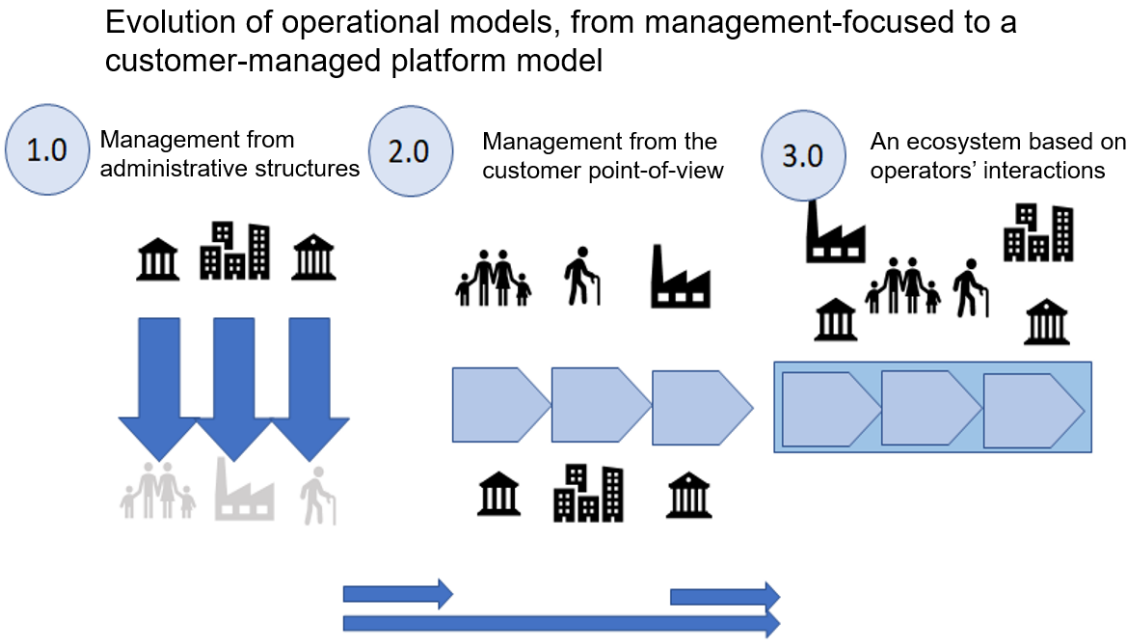

Figure 2. Evolution of operational models towards an interactions-based ecosystem.

In a digital and networked world, Finland's competitiveness is not affected by its remote location and small population. Crucial factors include interaction-enabling solutions, attitudes and skills. The technological revolution and the age of artificial intelligence require public administrations to take a particularly active approach and facilitate new ways of doing things, for example, through legislative reforms. The public sector plays a major role in enabling digital operations, and public investment is also needed to deliver more efficient and human-centric practices and processes. To ensure the efficiency of digital activities and the efficient production of digital services, the availability, quality and interoperability of information should be safeguarded, and reliable and secure information systems should be ensured. The use of information and technology should always be on an ethically sustainable basis. Data security and privacy must be guaranteed, but not by categorically blocking or compartmentalising the flow of data.

The greatest attention must be paid to ensuring that change is centred on people and their welfare and real service needs, and not on the technology itself. The availability, interoperability and quality of data, and data sharing without compromising on people's information privacy, are prerequisites to a human-centric service structure in the digital era. In creating a human-centric service market, the AuroraAI service model adheres to a set of common principles on digitalisation, which set out rules for data sharing and interfaces, models, rapid service development, and measures that ensure service continuity. The nine principles of digitalisation lend support to the leap in productivity, user-orientation and the primarily digital role of public services.

Figure 3. The nine principles of digitalisation serve as a common playbook and pillars of a human-centric society.

As a mechanism for steering the service markets, the focus needs to be on people's life-events and business/third sector activities that require a holistic view of welfare instead of focusing on narrower topics.

AuroraAI is an evolving service model that helps organisations to connect their operations and smart services to human-centric service markets that are centred around selected life-events and business activities. The Aurora network connects smart services provided by the public, private and third sectors and offers a gateway for their seamless interaction, thus offering a new way for service markets to deliver support and services for citizens exactly when they need them. In a human-centric society, activity is centred on an individual person or business or on society as a whole.

A vibrant service ecosystem requires trust, cooperation and ethical principles

Trust in other people, society and its institutions is the key force keeping society together, and it also serves as the basis for the Finnish model. However, rapid technological, social and cultural change poses a challenge to the Finnish trust based on shared values and predictability. In a complex, rapidly evolving and closely connected operational environment, trust can be lost in a heartbeat. In the future, the building and retention of the trust of citizens and businesses are increasingly important to success.

Digital trust in society can be created best in ecosystems that enable public administration, businesses, researchers and citizens to come together and develop solutions to challenges and seize opportunities offered by the technological revolution. Future-proofing is done in cross-sectoral cooperation and increasingly through collaborative development between the public, private and third sectors. Changes like those promoted by the AuroraAI service model can only be implemented if public administration trusts citizens, citizens trust public administration, and societal actors trust each other. Trust promotes cooperation and promotes the ability to respond to unprecedented and sudden situations. Trust is underpinned by strong ethical principles, openness and the inclusion of all stakeholders, especially citizens. Citizens' experience of trust is crucial to the development of an information- and trust-based society. Citizens must be seen as active contributors who have extensive rights to access and share comprehensible information in order to promote their own welfare.

The AuroraAI service model provides a platform to which organisations can connect to create value for people during various life-events. It facilitates ecosystems that serve the needs of citizens and businesses through seamless, human-centric and ethical delivery of smart services. However, trust requires transparency, responsibility and reliability. It can be maintained by assigning clear responsibilities for data management and ensuring that digital products and services are easy to understand, reliable, and secure in terms of data and privacy protection throughout their lifecycles.

The use of data and artificial intelligence can be trusted when it is done ethically. The reliability of artificial intelligence comprises two aspects: (1) its intrinsic purpose must be ethical, it respects basic rights, applicable legislation and key principles, and (2) it must be technically

reliable, since poorly executed technology can cause unintentional harm, even if its purpose is noble.

The ethical use of artificial intelligence requires a common ethical code that is accepted by all participants. The ethical code determines the core ethical principles of the Aurora partner network and provides the basis for the development and adoption of ethically sound practices. The code informs the development and implementation of AuroraAI in a human-centric and ethical way, which makes it worthy of citizens' trust.

The code is based on the principles of good governance in the Finnish public sector as well as other key legislation, including the GDPR, Data Protection Act and Non-Discrimination Act. The purpose of the ethical code is to ensure awareness of the existing codes and principles among the network partners, their application in the context of Aurora, and a framework for resolving ethical problems that are not governed by any known laws or the network's own codes of conduct.

The ethical code is a set of principles which inform the development of services for AuroraAI. It provides a framework for network-based cooperation and ensures that all of the developed services adhere to the same ethical code. The ethical code of Aurora does not replace organisations' own codes of conduct; rather, it provides a framework that facilitates dialogue, comparison and consensus formation in a multi-agency environment.

Empowerment of citizens through ethical use of data

To ensure efficient production and use of digital services, the availability, quality and interoperability of information should be safeguarded, and reliable and secure information systems should be ensured. The use of information and technology should always be on an ethically sustainable basis. The core idea of AuroraAI is the human-centric utilisation of personal data and situational awareness about welfare by combining strong data security principles with the ability to utilise data collected about and by the individual. Data flow must be ensured while respecting people's information privacy and other basic rights, and the personal use and management of one's own data must be enabled at the same time. Individuals should be able to produce data themselves and access it in usable digital format from the data controller.

Human-centric service markets are based on individuals' personal tools and means of managing and sharing their personal data according to the MyData principles. MyData refers to a new way of thinking which means that the management and processing of personal data move away from the current organisation-centred model towards a human-centric approach. The potential of data utilisation can be maximised and the erosion of privacy can be minimised by providing individuals with tools for the access, reuse and sharing of personal data.

MyData means that individuals have the right and practical means to manage and access their disclosed data and data collected by others about them, and share it to third parties when they want to do so. MyData is based on the right to manage personal data and the balancing of rights and rigorous security standards in a way that facilitates the availability of data. At the same time, MyData accelerates the development of data economy and open, human-centric

service ecosystems underpinned by strong data security. If the use of MyData can be realised, it will likely support the growth of data-based service markets centred around life-events in all sectors.

The AuroraAI service model is similarly aimed at empowering individuals to manage, utilise and understand their personal data flows. In the AuroraAI network, individuals can decide how to use their personal data to personalise their service offering and obtain personalised advice, recommendations and instructions by using intelligent methods.

Personal data are managed through consent management, which means that individuals can choose which services can utilise their personal data. Citizens are able to use their data to produce situational or temporary datasets or summaries, which can also access the Aurora services on an anonymous and untraceable basis. The networked services interact to produce services for situationally generated compilation profiles as efficiently and optimally as possible. It is essential that the use of consented data can be monitored and the consent can be withdrawn as and when required.

For users, this means having access to seamless, well-functioning and effective service chains that combine services from multiple sectors, services and service providers. In other words, Aurora's smart service ecosystem connects to the individual compilation profile to produce services tailored to situational welfare needs. The functioning of the Aurora network requires the user to voluntarily opt in to services and the ability to manage personal data and consent to its sharing with the applications of participating service providers. Personal data are used according to the user's current need and as anonymously as possible. Where data needs to be accessed in its original format, its use is governed by the MyData principles; in other words, the individual decides whether their data can be used.

It should be noted that the implementation of the MyData approach in public services is still an undeveloped area, especially in terms of legislation. The findings of the preliminary study show that it would require significant cross-sectoral efforts to define shared interpretations as well as preparatory work on legislation relating to secondary use of data.

What is AuroraAI?

Since a human-centric society is fundamentally about the holistic welfare of citizens, businesses and society as a whole, the fundamentals of how public organisations work must also change. The nature of the change is so profound that organisations must be supported through it. AuroraAI is an evolving service model that helps organisations to connect their operations and smart services to human-centric service markets that are centred around selected life-events and business activities. A new way of doing things and the utilisation of data and new technologies facilitate the development of services based on the needs of citizens, businesses and communities instead of it being driven by the needs of public authorities.

The human-centric approach materialises through life-event-based thinking, which informs service design and provision and enables people to support their own welfare and that of their loved ones through various life stages. Connecting the services and structures around life-

events is a prerequisite for a human-centric society. In order to create impactful services, well-functioning service chains that are centred around life-events and a service offering that efficiently utilises data, it is proposed that the government launch a programme for a human-centric society by implementing the AuroraAI service model for selected life-events and business activities. The model delivers targeted services and proactive referrals by utilising a decentralised open network of AI and smart solutions, which facilitates interaction between services and the creation of seamless service chains in a secure and ethical way. It also helps to tackle inefficiency and resource waste from the point of view of both citizens and public finances.

In a human-centric society, continuous service development and management are based on the identification of individual needs and the use of data repositories that describe these needs. In practice, it means improved awareness of people's needs and welfare status. Data on people's real service needs facilitates efficient targeting of services at the individual level. Shared, data-based situational awareness facilitates the targeting of effective services based on individuals' real needs and enables people to manage their lives more efficiently in various life circumstances.

AuroraAI is not a single service point; rather, it is a service network in which smart applications can reach people according to their life circumstances and events in a secure and ethical way. Public, private and third sector operators can connect their services to the network, provided that they are implemented using specific technologies and meet certain requirements.

Seamless, personalised and impactful services for citizens

From the citizen's point of view, the AuroraAI service model offers well-functioning and timely service chains, effectively targeted service concepts and personalised services. By managing their personal data, citizens can access services in a more holistic, personalised and efficient way than before. The core idea of the service model is to enable impactful and cross-sectoral service chains to reach citizens in a personalised and, if they so choose, proactive way.

Artificial intelligence enables citizens to access services in a more diverse, interconnected and convenient way than is currently possible. Instead of citizens having to identify which services they need, the services can be matched to their needs. The Aurora network and interconnected smart services facilitate a service market that can offer support and services to citizens as and when they need them. Instead of referral by authorities, the service referrals are based on the history data of service chains, which have been proven in use. The extensive service market offered by AuroraAI helps citizens access consistent and high-quality digital services all over Finland. The provision of digital support, education and advice will be a core skill in future society. Citizens must be able to log into services in a secure way and manage their digital identity and personal data.

The MyData approach gives citizens a new kind of situational awareness about their personal welfare. When accessing services, individuals must be able to share pertinent personal data in a situational, temporary and secure way. The right to manage personal data will be increasingly seen as a basic human right in the digital era. Government agencies and

companies must ensure that the information is managed in a responsible and competent manner, that it is extensively available and of high quality, and that the rights concerning the use of the information are observed.

Instead of referral by authorities, citizens can be referred to services by new technologies and the AuroraAI network based on proven uses of services in comparable life circumstances. Artificial intelligence facilitates learning and forking of service chains based on proven uses in the context of specific needs, which will significantly improve the matching of service recommendations and suggested alternatives. In the future, services provided by the public, private and third sectors must be able to respond precisely to citizens' actual welfare statuses and service needs.

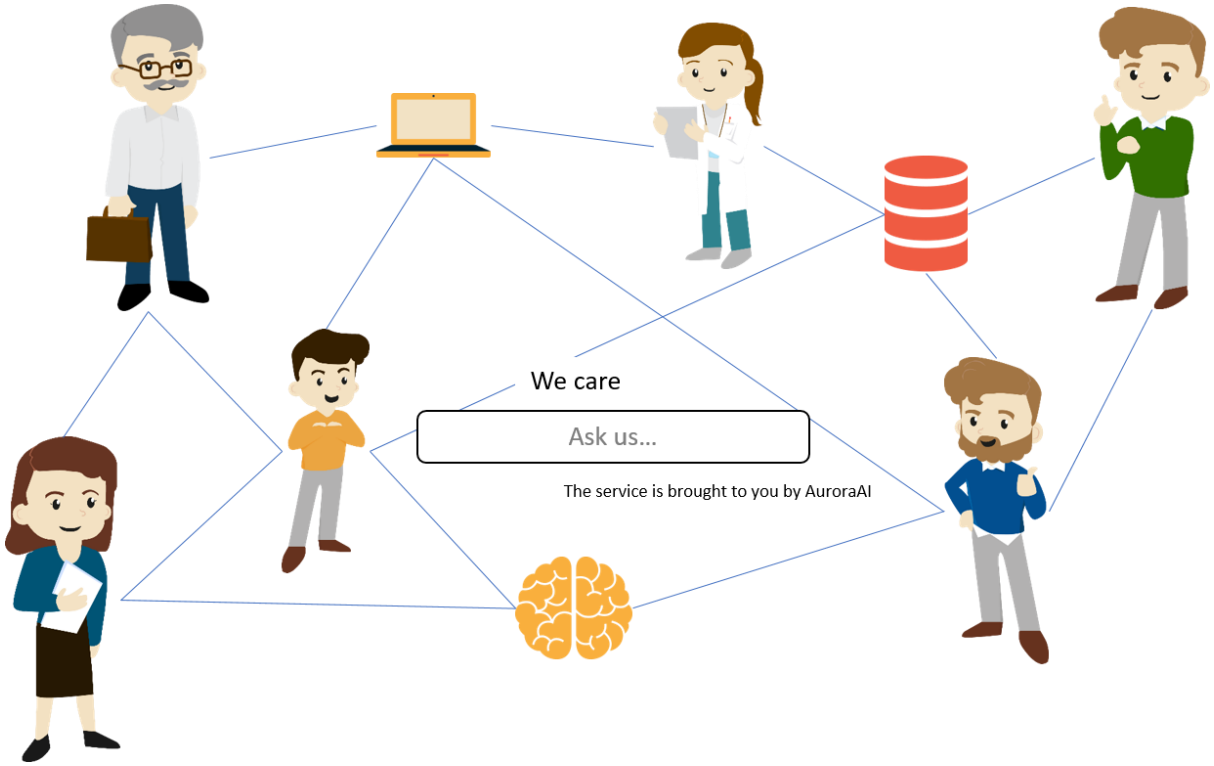

Figure 4. AuroraAI offers citizens a new kind of situational awareness about their holistic welfare and the ability to activate services based on individual life circumstances and events in a secure and ethical way.

Management by shared situational awareness

The building of services around citizens' life-events and according to demand poses a challenge to existing structures and management style. In the future, services must be managed based on data and situational awareness about citizens' welfare, which means targeting solutions at citizens' actual needs. The current management style in public services is focused around organisational management: organisations are steered by legislation, performance management and financial management.

The advantage of organisational management is production efficiency, as well as the fact that it is highly suitable for producing one-time services and products. However, it also involves

challenges, including how to understand customers' needs relating to their holistic welfare and prevent resource waste caused by oversupply in one area and lack of services caused by under-resourcing in some other area. One specific challenge is the low impact of services in situations where they are offered to a customer base with extensive needs that cannot be met by limited one-off service transactions (so-called 'wicked' problems or customers with multiple issues). In organisational management, goal-setting and performance agreements are primarily based on production outputs instead of their impact for people, which means that services cannot resolve systemic societal problems or produce proactive services since they are reactive by nature.

Human-centric (customer-focused) management fundamentally differs from organisational management in that it is based on the current situation of individuals (customers) in terms of both the volume of demand and the recognition of needs. In strategic decision-making, segments (customer groups) are identified in order to develop a range of service concepts, and key priorities for impact are defined. At a tactical level, situational awareness provides market operators with better visibility, which they can use to develop well-matched services and improve their service capacity management. At the individual level, situational awareness empowers individuals to manage their personal welfare, access services and choose appropriate service packages.

Compared to organisational management, the advantages of human-centric (customer-focused) management are better service-matching and impact for people (customers). Services are produced and developed in cooperation with people (customers) and according to actual demand among the relevant segment (customer base). In a human-centric (customer-focused) model, organisations share situational awareness and segment data (customer data) and thus work together to serve people (customers) based on various network-based collaboration models.

The AuroraAI service model brings together organisations under a customer-focused co-management model that is cross-organisational and cross-sectoral. The service model enables customer data to be collated and processed for defined purposes in a way that facilitates the provision of services matched to a specific life-event. The collation of data facilitates the creation and management of situational profiles that can be matched to specific needs in the life-event-based service ecosystem. The situational data is interpreted and acted upon by the ecosystem operators. The ecosystem operators generate and share data to the system on an agreed basis in order to support the operation and development of the system as a whole. Shared situational data and customer data facilitate the referral of people who are in specific life circumstances based on peer suggestions and experience so that they can access impactful and well-matched services.

Providers of customer-focused AuroraAI services can experiment with and develop their management models for selected life-events in partner networks. The AuroraAI model supports experimentation with co-management models in customer-focused life-events and situations (phenomena). Consultations should be carried out with the management and key developers of participating organisations to review the principles of AI-based ecosystem management and ensure the management's commitment to the service model and the new, customer-focused practices.

In the preliminary study project, development managers' competence development was trialled in Tampere in a three-phase coaching programme, which covered the basic principles of artificial intelligence, ecosystem management, situational management, and management in complex environments. The coaching programme included one-to-one coaching and the preparation of individual change plans to facilitate the development of a customer-focused model. One important aspect was dialogue between the participants and ensuring that the participants had a sense of learning and ownership in the process.

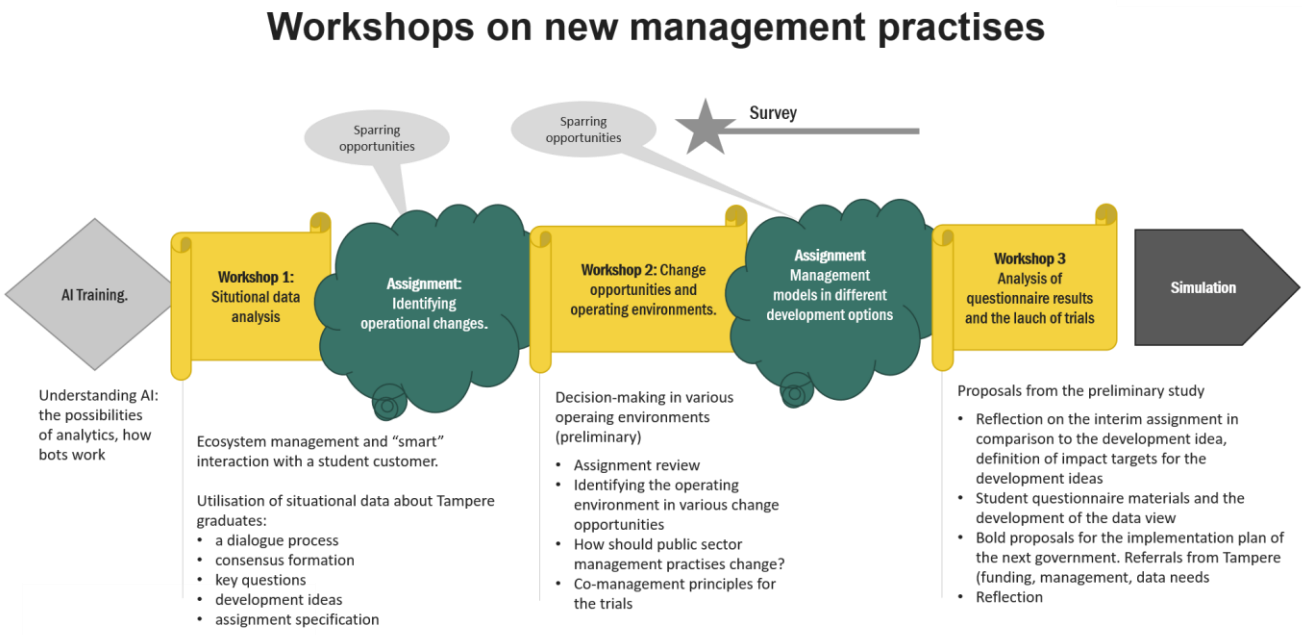

Figure 5. A series of workshops on new management practices implemented by City of Tampere as part of the preliminary study project for the Aurora national artificial intelligence programme.

The AuroraAI network and an intelligent service partner network

As an artificial intelligence project, AuroraAI seeks to respond to new kinds of challenges in a modern, digital society. Instead of a single AI solution that would become obsolete within a few years, AuroraAI aims to establish a network of intelligent services that can be developed collaboratively by operators from the public, private and third sectors. AuroraAI enables diverse contents to be connected to the AuroraAI network on an open basis, which means that all network members have a content provider role (i.e. creator of new services). The service-oriented model also enables closed implementations on top of the open architecture. The service-oriented architecture facilitates decentralised technical operation and a network-based multi-operator environment. The service-oriented approach means that the operations of different participants can be separated into entities with minimal interdependencies.

In a technical sense, AuroraAI is not a website, portal or interface; rather, it is a way of connecting services together. Interfaces that are visible to citizens (e.g. websites, speech

recognition, chatbots) are also treated as services, and AuroraAI does not specify how they are implemented or by whom. The essence of the system is that interfaces function according to the common rules and standards of the AuroraAI network. Similarly, AuroraAI does not specify whether the connected services should be digital or services delivered by conventional means. The network can also be used to distribute information about services. All services are operated according to the common logic and utilised to support other services.

The world is not digital. However, in the digital era conventional services can be enhanced by ensuring that they are delivered in the right order and by combining them seamlessly with digital services. These blended environments can consist of a mix of services from the digital and physical worlds brought together by the standard interface. When real-world services and functionalities are made available in the Aurora network, it can utilise them in the same way as application-based features. Services are connected seamlessly with digital services and they can benefit from the advantages offered by the network environment.

Dynamic competition

In the AuroraAI network, operators from the public, private and third sectors work together to identify the best service concept for a given user, which can consist of a number of different services from different sectors. The service concept and experience undergo an automatic bidding process in which service combinations that offer the poorest end result are gradually eliminated. The most efficient, optimal and comprehensive service chains win the bid.

The AuroraAI network can consist of multiple services from different service providers who operate in the same sector and offer similar services. This enables dynamic competition between the participating suppliers. An example scenario:

A university town is covered by a number of student advice bots that are operated by a number of universities and businesses. Some of the bots function better than others, i.e. they are better able to respond to people's actual service needs. Based on user experiences, the Aurora network starts to prioritise the suggestions of bots that have been found more accurate. For example, in this scenario the most popular service could be a bot that compiles its service by sourcing information from other bots – in other words, by networking with other services.

All services operating in this branch of the AuroraAI network benefit from the increased usage rate, which may involve compensation. Effective matching of demand and supply generates added value. Even micro-level operators benefit when they generate added value, since any service that has generated value will be automatically included in a larger service concept to which it has contributed.

Network administration and reward mechanisms

The AuroraAI network is envisioned as an open network, but it does not mean absence of control or operator responsibility. In the administration model, a service that is placed higher in the network hierarchy (a parent node) has authority over services that are lower in the hierarchy.

The AuroraAI network can feature several reward mechanisms for motivating operators to develop new services. A higher-level service can determine the mechanism (and other rules) that apply to the subnodes in its network (e.g. token-based solutions). The token-based model of administration and rewarding was investigated as part of the AuroraAI preliminary study project. The findings show that the Aurora network could benefit from blockchain systems, which are more open, but they should be analysed and tested in smaller environments first.

DigiMe – the user's digital persona

In the AuroraAI network, DigiMe refers to the way a user can utilise their personal data in the network. Services that are based on personal data provide users with better understanding and control over their welfare and the ability to activate services in real time. The key feature is that the user is able to manage their own data and edit them into situational, temporary profiles in order to access a personalised service offering.

The network aims to predict the user's needs and improve the service experience by formulating a coherent overall view of each user. This is done by comparing the user's characteristics, i.e. the data shared by the user in a given situation, with other users in order to identify similarities, differences and patterns. The only way to objectively understand an individual is by comparing them to a mass of other individuals. However, it should be noted that the user must not be identifiable at any stage, if the comparison is to be done on an anonymised basis. The DigiMe concept can be developed in cases where the connection between the real-world person and their digital persona needs to be made invisible. The user collates their personal data to produce a compilation or summary that can be processed by the network without connecting it to the user's source data. The development and controlled testing of such a concept are important methods in the transition towards a human-centric society in which users can trust data privacy.

Impact and timely services from artificial intelligence

AuroraAI is a network of intelligent services. Its intelligence can be conceptualised on two levels: within individual services that are not dependent on a specific technology or manufacturer, and within the network formed by such services as a whole. Like the Internet, AuroraAI does not specify what services it contains or how they are produced. And like the Internet, AuroraAI can be used in many different ways (cf. email, websites, instant messaging, etc.) Since it is impossible to predict future technological advances, the network's functionality should not be tied to specific algorithms, use cases or interfaces. As a whole, the system seeks to create an optimised and seamless service experience by combining several different sources to match the personal and situational needs of a given user.

In the coming years, artificial intelligence will play an increasingly important role in the way services are produced and organised. AuroraAI utilises artificial intelligence in at least the following ways:

- **Identification of service needs from natural language.** One of the core ideas of AuroraAI is its aim to make services easier for citizens to find and to improve the availability and accessibility of services. Artificial intelligence can be used to implement service discovery methods in which the citizen expresses their service needs in natural language, typed or spoken, whichever is natural to them. The system must be able to understand different types of expression of a specific service need and provide access to the service regardless of how the need is expressed.

- **Prediction of relevant services.** The 'supervised learning' paradigm of machine learning facilitates prediction of relevant services, when the artificial intelligence model receives input about the person or a reference group (segment) that he or she represents. AI learning requires both descriptive data about users and history data about services they have used previously. For this purpose, reinforcement learning is used, which is influenced by users' subjective experience of the quality of the service as a whole and data available about the user. At the same time, it produces additional data about end users' actions and needs, which can be used to create new service paths or new services as and when new needs are identified.

- **Compiling of service packages.** The service chain offered to the end user consists of a number of individual services that are selected intelligently from among the thousands of services that make up the AuroraAI service offering. Compiling can be computerised and done in real time. Optimisation (better, more cost-effective, faster, etc.) is a classic topic in artificial intelligence. Other important matters include the order of service deliveries and complex dependencies and cause-and-effect relationships, and they can be determined automatically (for example, a social assistance application first requires bank account information, and obtaining this information in advance reduces the need for human work). Automated task planning makes life easier for citizens and increases their sense of control by making the service processes visible (cf. situational data).

- **Management by information.** In the context of management by information, an integral part of AuroraAI is unsupervised machine learning, which is based on macro-level analysis of data observed about people. Machine learning can be used to analyse what types of groups, segments or clusters a customer base contains, provided that the dataset is sufficiently large. Machine learning can be tasked to search for the segment structure and link the user to a particular segment. The segment structure can be used to evaluate the service offering available. In addition, data can be combined from several different services in order to create a data resource that is as useful as possible, which in turn enriches the resource used in the segmentation.

- **Service referral and development and organisation of services.** Data resources and segmentation facilitate individualised targeting of measures, such as accurate service referrals, and thus help eliminate problems like service matching issues and failure demand.

- **Transparency of artificial intelligence:** The ethical code of AuroraAI requires that services should be sufficiently transparent to enable citizens to evaluate services based on key information. Such information includes e.g. the service owner, the

operating logic of the algorithms or recommendations, the service providers, and guidance on the user's rights in the event of an error or harm. In AI decision-making, evolving technologies that enable the AI to explain its decision-making chains, parameters and conclusions should be used.

A human-centric approach transforms investment-thinking

In current decision-making processes, it can be difficult for individual organisations to justify investment in promoting a human-centric society, when each organisation is only responsible for its own duties and services. Instead of real-world life events and business activities, service development is steered by statutory tasks and their delivery. This leads to fragmented services, and nobody has statutory responsibility for the delivery of seamless service chains. In other words, the seamlessness of customer paths is not protected by law.

According to section 8 of the Administrative Procedure Act, "an authority shall, within its competence, provide its customers, as necessary, with advice on dealing with administrative matters and respond to questions and enquiries concerning the use of its services. Advice shall be provided free of charge. If a matter does not fall within the competence of an authority, it shall seek to refer the customer to the competent authority."

AuroraAI offers public organisations a new way of carrying out their advisory duty in the AI age. The AuroraAI network concept enables an organisation to receive service requests from people and businesses and refer them back to the network if the matter is not within its competence. Requests that are referred back can be dealt with by another competent authority or organisation that is capable of fulfilling the customer's need. This means that services can also be offered by the private and third sectors in a secure and ethical way.

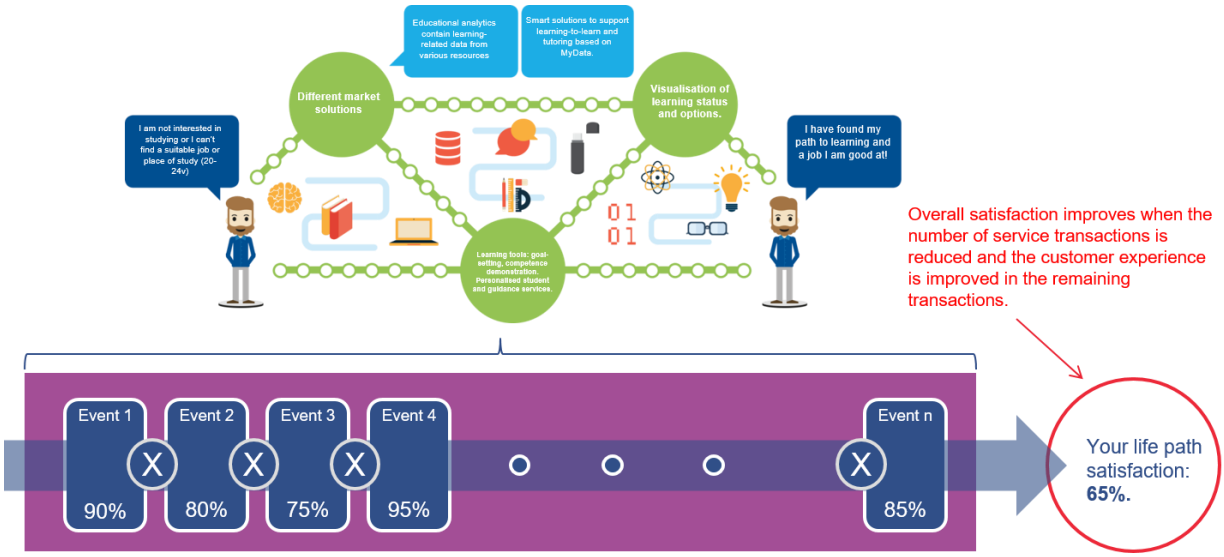

Figure 6. Investment-thinking changes when organisations plan their operations in cooperation with all relevant stakeholders. The life-event approach provides organisations with a new framework for investment.

The new model helps to shift operators' investment-thinking towards the ecosystem approach. In the AuroraAI service model, investments are targeted at creating a vibrant service ecosystem. It means that instead of allocating investments to the development of individual services, they can be focused on creating mechanisms that enable life-event services to reach people at the right time and in a secure and ethical way. One example of this is described by the "well-being of children and parents in changing family relationships" life-event pilot. In the pilot, several smart applications were created to map the service needs of individuals in a divorce situation and suggest suitable services from the ecosystem. In this case, the investment is targeted at the mechanisms that enable the mapping of customer needs, while the actual services can be delivered in a human-centric, proactive and ethical way.

The AuroraAI service model enables organisations from different sectors to generate situational welfare data that supports human-centric service provision, participate in a coaching programme that supports organisational change, and connect their operations and smart services to a human-centric service market that is centred on selected life-events and business activities. A new way of doing things and the utilisation of data and new technologies facilitate the development of services based on the needs of citizens, businesses and communities instead of it being driven by the needs of public authorities.

Responding to societal challenges such as the sustainability gap of public finances, ageing populations and the marginalisation of young people requires a sound understanding and cross-sectoral situational intelligence about citizens' real-world needs and welfare status. Situational data requires new ways of leveraging data as well as new data analytics methods and other AI solutions. Services can be targeted efficiently based on information, which leads to service chains that are seamless, tailor-made and impactful from the citizen's point of view. At the same time, services can be allocated more economically, and resource waste and underuse can be reduced.

The long-term sustainability of public finances in Finland is not adequate, and the sustainability gap is yet to be resolved. According to a recent economic survey, the sustainability gap is nearly 4% relative to GDP, or approx. €10 billion at 2023 levels. It is therefore evident that as large age groups retire, including from the public sector, Finland will have a unique opportunity to transition into the AI age in a cost-effective way while increasing public sector productivity. However, this cannot be achieved without changing the way we do things. Autonomous decision-making and the interaction of services and smart applications to serve the needs of people and organisations are the core tasks of the AuroraAI service model.

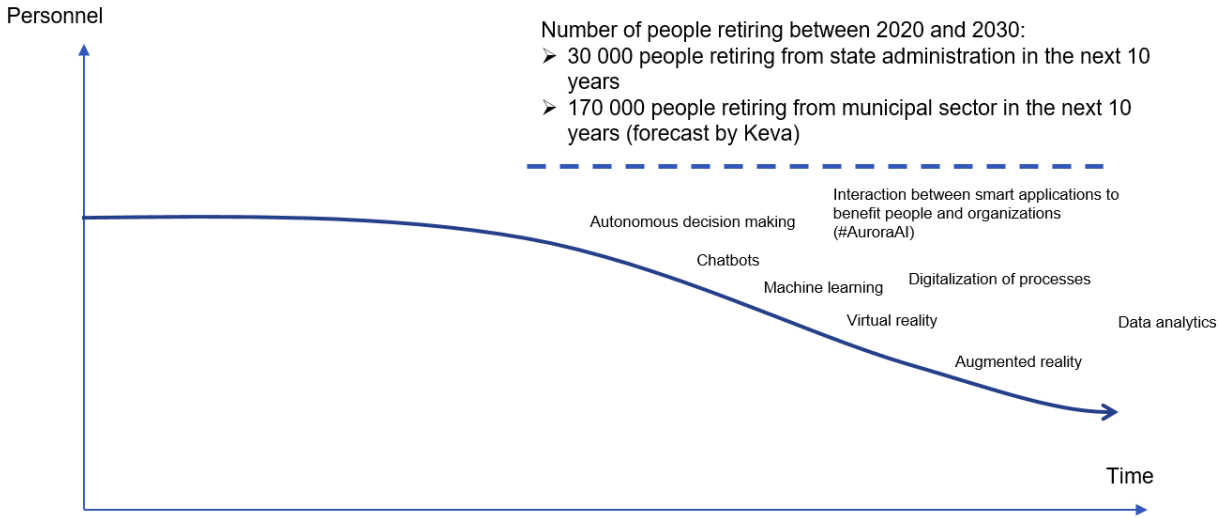

Figure 7. AuroraAI creates the prerequisites for the maximum utilisation of technology in conjunction with mass retirement and supports growth of productivity in the public sector.

Current budgeting practices reduce overall efficiency. Reforms are difficult to implement if policies are used to steer output, e.g. the number of visits, time use and so forth. This means increasing demand for appointments, service transactions etc. Service demand then holds value in and of itself and becomes a measure of success. As demand increases, more people have to be recruited and costs rise. The focus is ultimately on managing costs – which means that our focus is on the wrong things.

All this leads to failure demand, which does not generate value for customers. It also means that customers are passed between agencies. As long as our focus is on efficient processes and demand, we are unable to understand and serve customers' real needs. AuroraAI enables us to respond to customers' real needs in a holistic way. Failure demand is significantly reduced, and services that produce genuine value can reach customers in a timely and proactive manner. Research shows that in some organisations, failure demand can account for up to 80% of operating costs. That is why our focus has to shift from customer service in and of itself to the speed of fulfilment from the customer's point of view. This is also the core idea of Lean thinking. Currently, costs are constantly running away, because operations are not managed from the perspective of understanding customers' holistic needs proactively and collaboratively. That is why shared situational data about a customer's situation is a key tool in the AuroraAI service model. It allows everyone to reflect on and modify their behaviour to help reduce failure demand.

As stated by the Ministry of Finance, achieving this change requires a shift in focus from the monitoring of costs to the monitoring of the service effects and to examining the development funding and the benefits arising from it as investments boosting the effectiveness of the activities. Development promoting joint objectives should be supported with projects crossing the boundaries of administrative branches. This operating approach should be strengthened with a steering model for digitalisation investments, through which the preparation of the funding decisions for major digitalisation development projects funded from the Budget should be channelled. Adopting more investment-oriented thinking requires the formation of a comprehensive and shared information base on the areas for investments and comparisons

between their productivity potential so that the renewal process can be steered in a strategic manner.

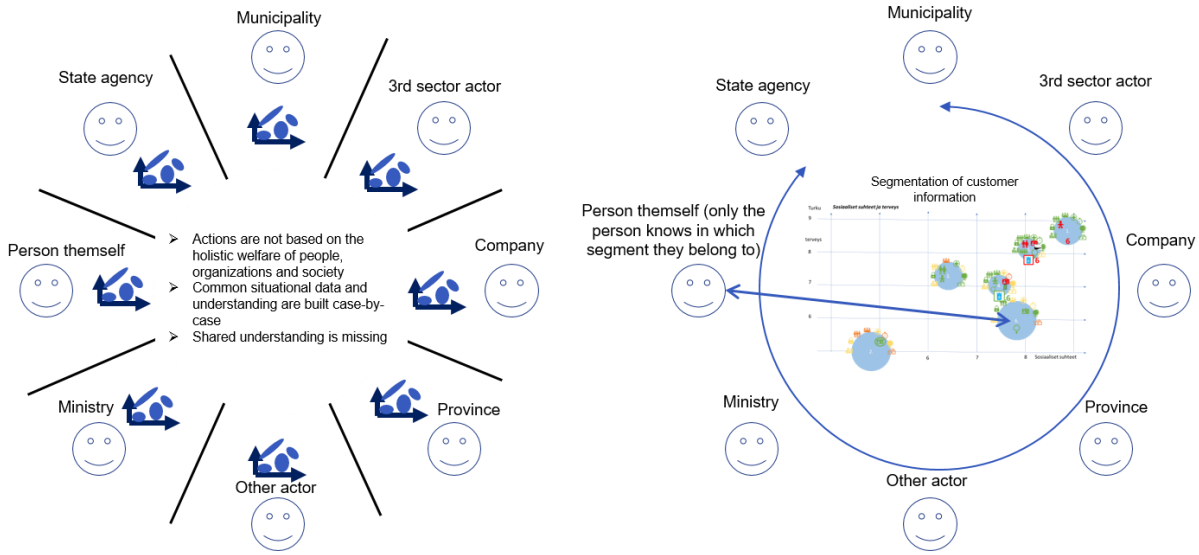

Figure 8. Shared situational intelligence eliminates the passing of customers from one office to another and significantly improves efficiency. Investments can be targeted at maximising value to customers.

Technological advances facilitate the development of new intelligent and more impactful services and the creation of more efficient service chains that respond to the real needs of people and businesses. Services can be targeted at people's actual needs and helping them in various life events. Artificial intelligence can be used to learn which services are useful and effective for which types of needs, and services can be targeted efficiently.

A new way of investment-thinking creates new opportunities for agencies such as Business Finland to create funding instruments for ecosystems that are centred on life-events, which enables investment impact to be targeted precisely to the real needs of people and businesses in accordance with the platform economy model. This means that markets can be incentivised to connect their services to people's real-world life events and business activities. Funding instruments could be available for joint applications by ecosystem operators. The Finnish State Development Company VAKE could invest in operators that are working in the AuroraAI network on solutions to major societal challenges. Local authorities could collaborate to create e.g. service bots and situational data.

> *Leading AI countries could capture an additional 20 to 25 percent in net economic benefits. (Source: McKinsey & Co., Notes from the frontier: Modeling the impact of AI on the world economy, September 2018)*

Investments that support the development of service ecosystems require a new form of contract management. Current contracting methods do not support ecosystem activity. Innovative contracting, the alliance model and partnership agreements should be adopted more widely. The AuroraAI service model facilitates dynamic tendering for agile contracts delivered by the network partners. A separate contracting model can be agreed on and created within the network. Allocated funds will be targeted at developing the vitality of the selected

ecosystem in accordance with the Act on Public Procurement and Concession Contracts. It is essential to create contracting models that also facilitate market entry for innovative start-up companies that can create more value in the evolving ecosystem.

> *Products that became platforms in the period 1990–2004 increased their innovation capability by 500%. A significant proportion of growth came from external (application) developers. (Source: Boudeau, K. 2010. Open platform strategies and innovation: granting access vs. devolving control.)*

The AuroraAI service model provides the service ecosystem operators with a shared environment in which they can collaboratively produce value for customers and each other through their operations and outputs. The operation is based on agreed rules. AuroraAI involves identifying investment models for the development of the ecosystem in cooperation with the ecosystem operators. They can include innovative contracting, the alliance model and innovation partnerships. Hansel is a key operator to engage in this work.

In addition, the implementation of the service models requires a change support team and personnel recruited for each anchor organisation that adopts the service model.

A human-centric approach requires new skills and capabilities

In the future, smart services and new technologies such as AI will be an unavoidable part of our daily lives. The scaling of smart services into society's service structures must be done in a responsible, ethical and sustainable way, which requires new skills at all operational levels. The development of AI and data/platform economy solutions in a human-centric way requires new, diverse skills and a combination of disciplines including data sciences, data analytics, service design, software development, social and behavioural sciences, ethics and industry-specific expertise. Users need to be able to use the solutions and understand their possibilities and limitations, and they will need trust and courage to try new things and look into the future. For example, calculations done by machine learning algorithms should be explained to users so that they can understand why they were given a specific result.

Requirements relating to the development of citizen competencies will increase as the digital revolution progresses, but the change presented by the AuroraAI service model poses some additional requirements. Every citizen should have strong information literacy skills: the ability to source, interpret, understand, modify, produce, present and use information and assess its usefulness and accuracy. Creative use of information requires internalised knowledge and comprehension. Competence development also requires the ability to understand ethical questions relating to the use of information and data. People will need to be able to make informed personal decisions in a digital world.

And more generally, from the point of view of both inclusion and trust, competence development is also needed in areas such as data and platform economies, data protection, cybersecurity, use of personal data (MyData) and new technologies. AuroraAI requires the ability to verbalise personal needs and utilise personal data in a range of situations and poses questions about information management as well as inclusion and agency. Citizens need

digital and equipment skills and the ability and opportunities to participate in the development of the ecosystems. The solutions should give a genuine sense of inclusion and a high level of usability.

Competence development in organisations

In most organisations, the implementation of the AuroraAI service model will require development of competencies and new practices. The development needs depend on the maturity and tasks of the organisation. For example, the development process could start with experimentations to get an understanding of what types of changes are needed and to identify the benefits of the approach.

Competence development needs have been identified in the following areas: management, the operating principles and rules of the ecosystem, experimentation and development competence, service design and identification of customer needs, learning and renewal capabilities, impact and measurement, data processing, and technology competencies.

From the management perspective, AuroraAI requires the ability to generate a new kind of situational intelligence about the context of the experimentation from the customers' point of view and the ability to interpret and assess situational data. This leads to a more holistic understanding and new possibilities to develop operations to match customer demand. Situational intelligence requires knowledge about existing data. Other management-related aspects include the creation and use of new types of indicators, facilitation of management-by-information and related skills, and the adoption of the necessary tools at different organisational levels. Change management is an essential part of the early stages of the process, and it needs to take into account the characteristics of the organisation in question and its roles in external clusters or ecosystems. In order to facilitate change, the roles of different personnel groups may need to be adjusted or completely redefined to support the adoption of the possibilities of artificial intelligence and data and platform economies by way of experimentation, training and peer learning as part of the personnel's core tasks. It is important to develop the personnel's ability to reflect on and adjust their work practices so that they can take full advantage of the opportunities of digitalisation. The new competencies will support the efficiency and impact of public services in line with the objectives of AuroraAI. In particular, the adoption of AI will affect all tasks that involve some degree of internal or external customer service or the development of technological solutions. Workloads will not reduce, but the work practices will change and job contents will be enriched.

Organisations' ability to measure and assess the effects and impact of new practices and services will play a significant role. It requires organisations to develop their assessment competencies, including large-scale assessment and research of impact and effects, and the ability to scale effective solutions to serve citizens.

In terms of technological competence, the adoption of the service model requires capabilities relating to the latest technologies and their application, interface solutions, data processing and quality, responsibilities, and the accuracy, consistency and availability of data. Special attention must be paid to identity management and identification methods, a good grasp of infrastructures, and the common rules on identifiers and operations.

With regard to experimentation and development competencies, those who implement experimentations should have the necessary capabilities to carry out development work based on open dialogue and design solutions in cooperation with citizens in accordance with the AuroraAI service model. Suitable ecosystem operators and other AuroraAI partners should be involved in the implementations. The management of experimentations requires strong dialogue and facilitation skills and the ability to implement agile processes in a complex environment. Before starting an experimentation, the current status should be analysed with the participants, and indicators should be identified for measuring the outcomes of the experimentation. Situational awareness and the setting of goals and indicators from the point of view of users' welfare requires the ability to identify information sources, the ability to use and interpret information, and the ability to use management-by-information tools. Contracting and acquisitions relating to experimentations and development work on a tight schedule require comprehensive knowledge of procurement practices. Service design competencies are needed in order to identify development needs in service processes from the point of view of service fluency and impact, and to design solutions in cooperation with customers during the experimentation. Experiences and lessons learned should be described on an action-research basis and communicated effectively. After each experimentation, the effects and impact are assessed and the scaling potential of the solution is described.

AuroraAI implementation 2019–2023

Implementation of AuroraAI in the next government term

The next government has a unique opportunity to transition Finland towards the AI age in a human-centric, secure and ethical way. AuroraAI provides a practical framework for this goal.

1) **Appropriation of €100m (Ministry of Finance) for the implementation of a human-centric, secure and ethical society in the AI age.** Funds to be distributed across the 2020–2023 period as follows: €20m 2020, €20m 2021, €30m 2022, €30m 2023). The appropriation can be used to launch approx. 10–20 service ecosystems for selected life-events and business activities. Establishment of a cross-sectoral preparatory working group to review and present funding proposals based on applications for the implementation of AuroraAI service models.
2) **Launch of a rigorous consulting process with citizens and businesses to identify key life-events and business activities that should be made more efficient and effective.** The prioritised life-events and business activities provide the basis for the selection of the service ecosystems to be funded. Funding is planned and submitted for approval on a case-by-case basis.
    a) Identification of important societal phenomena (e.g. lifelong learning, issues in service matching, young people's life management issues and marginalisation, problems relating to wellbeing at work) that could benefit from a human-centric approach and the use of artificial intelligence.
    b) Open invitation to field-specific experts and AI developers to formulate descriptions of the challenges/subproblems that the ecosystem should seek to resolve in the context of the phenomenon in question
    c) Formulation of a playbook for the ecosystem (e.g. data economy, technology, legal matters, rights, responsibilities, authorisations and liabilities) in cooperation with the ecosystem operators. The aim is to create a collaborative, reliable, reciprocal and vibrant ecosystem.
    d) Launch of "challenge competitions" in which ecosystem operators can organise into "consortiums" and synergies to find solutions to the given challenges

i) The solutions should be evaluated based on clear criteria (e.g. benefits to individuals/society; the feasibility of the solution) and the panel should include independent experts (cf. peer review systems)
ii) A significant proportion of the funds should be allocated to these innovative contracts/experiments

e) Evaluation of the benefits and impact of experiments, support for the scaling of best solutions
i) Funds should also be allocated to the scaling of the selected solutions; alternatively, investment-type instruments could also be used in cases where a solution would bring significant economic benefits and attract SIB investors

3) **Launch of the operational change process for selected life-events and business activities.** Launch of the implementation of human-centric service ecosystems centred on the selected life-events and business activities (see figure below). Request for proposals from public sector organisations on the implementation of human-centric service ecosystems and activities using smart applications and artificial intelligence. Formulation of agreements between the Ministry of Finance and the anchor organisations to support the funding decisions. Anchor organisations are performance-managed public sector organisations that are responsible for the establishment of a service ecosystem in their sector. Applications are interconnected via the AuroraAI network. Revision of the implementation plans for the implemented life-event pilots.

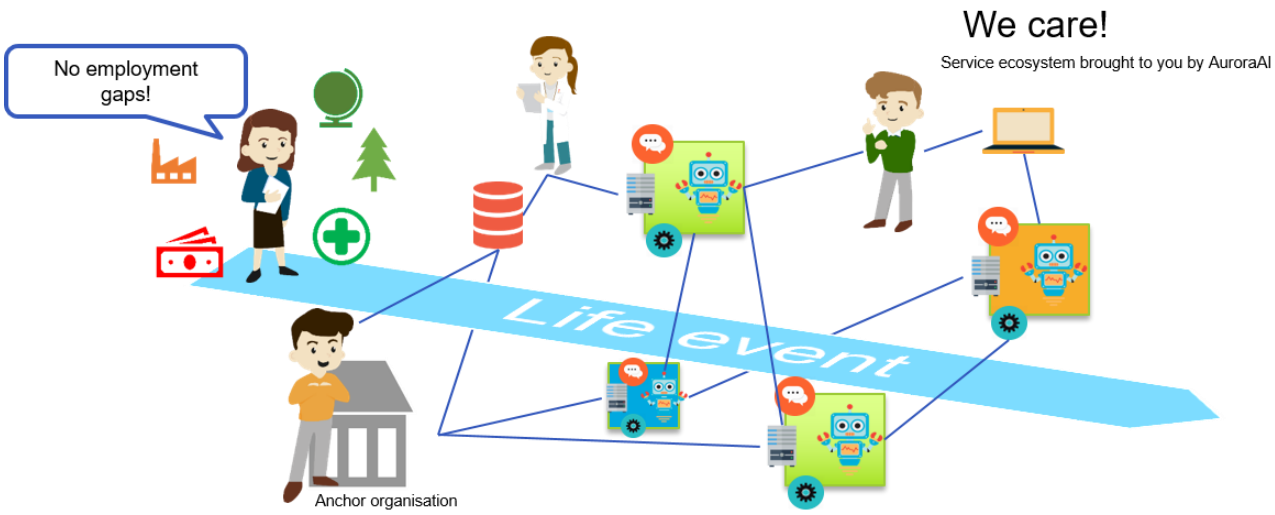

Figure 9. Establishment of a human-centric service ecosystem around a selected life-event or business activity.

4) **Supporting the implementation by establishing a change support team and a central AuroraAI response centre. Establishment of a support function for the AuroraAI network under the Population Register Centre.** The team supports organisations that are implementing changes, develops a management-by-information model based on data about service users' needs provided by AI, and formulates a playbook and guidelines in cooperation with the organisations implementing the change. The agreed rules can cover e.g. different actors' responsibilities, roles, the application of law and the uses of technology in the model. In addition, the team reports strategic situational data on welfare to support decision-making by central government. The tasks of the AuroraAI network support team are described under "Population Register Centre's tasks in AuroraAI".
a) Start of the development of a customer-focused operational model
b) Launch of the coaching programme for key organisations

c) Generation of dynamic situational intelligence about the selected life-event / business activity to support the management of key organisations (eliminating uncertainty)
d) Launch of an inquiry on organisations' competence development needs and a subsequent development programme.

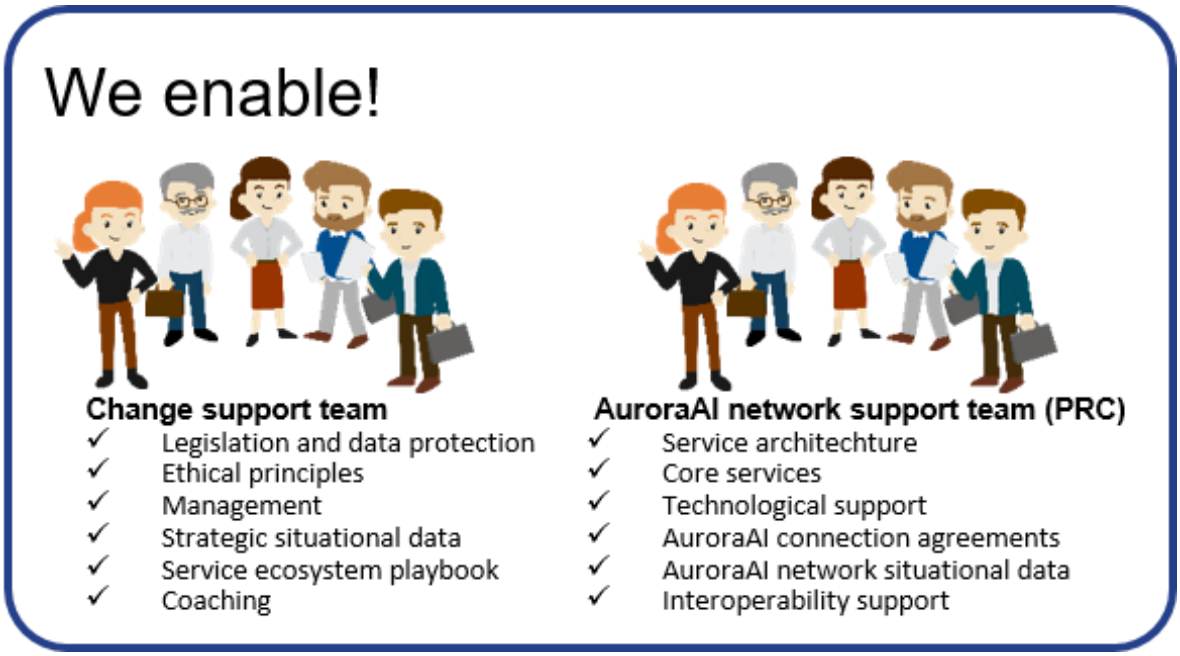

Figure 10. Organisations that are implementing the change are assisted by support teams.

Implementation requirements

Ensuring the ethicality and legality of AuroraAI requires a comprehensive work package for the further development and adoption of the ethical principles. From the point of view of the feasibility of AuroraAI, critical actions include the definition of a shared legal framework of reference to support and steer the legality of the network's operation, and to create effective mechanisms that support the identification and processing of legal questions with a cross-sectoral approach.

In addition, there is an identified need to create a regulatory sandbox environment for MyData that facilitates investigation in a restricted environment of the possibilities for secondary use of personal data collected by public services and to prepare legislative reforms in cross-sectoral cooperation, such as are needed to facilitate the new uses of data. The aim of the proposed sandbox environment is to 1) facilitate public sector MyData experiments in a closed environment based on data volunteered and consented to by citizens, 2) investigate whether new technology offers citizens benefits from the use of data collected by the public sector to such an extent that it will be necessary to extend the scope of the statutory obligations of authorities or facilitate secondary use of data by third parties, e.g. based on citizens' consent, 3) prepare for the agile and cross-sectoral implementation of legislative reforms, if deemed necessary.

The sandbox environment is specifically designed to respond to core questions relating to the purpose principle and the secondary use of data by interpreting and developing legislation

alongside the adoption of new types of data and the promotion of technological possibilities. One concrete example of the necessity of this type of sandbox environment is the Koski service. Administered by the National Agency for Education, the Koski service is being developed into a data repository for lifelong learning that serves as a centralised system for learning records in place of separate registers. A separate statute on the Koski service has been passed which specifies that individuals can consent to the sharing of their data from the database for secondary uses. The development of new AI-based public services requires the identification and preparation of the necessary legislative instruments to facilitate the use of people's data in a cross-sectoral manner.

> *Act on the National Registers of Education Records, Qualifications and Degrees*
>
> *Section 29(5) Sharing of data from a service*
> *A person whose data is held in a register or repository as meant by this act can give and cancel their identified consent in the service for the disclosure of data held about them in the register or repository to an authority or another entity. Data can be disclosed electronically via the education records information service based on the individual's consent.*

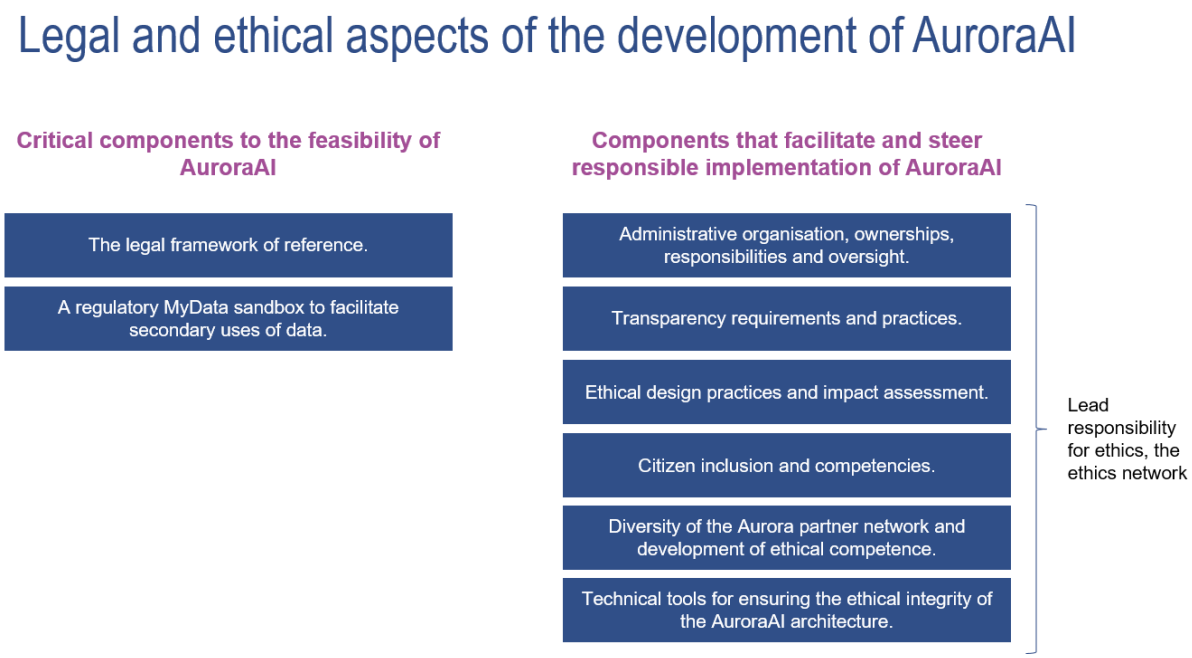

Figure 11. Legal and ethical framework for the implementation of AuroraAI.

In addition to ensuring the legality of AuroraAI, common rules and mechanisms are needed for the adoption and management of the ethical code as part of the AuroraAI network. Crucial matters include e.g. issues relating to responsibilities, oversight, transparency, ethical design practices and the continuous inclusion of citizens. AuroraAI should be seen as an opportunity to create globally leading practices and procedures for the implementation of ethical principles relating to AI in the context of public services.

Other identified requirements (i.e. commitments required from the anchor organisations) include:

1. The executive management of the anchor organisation must commit to the change

2. The operations must be iterative by nature. The service ecosystem can only be developed by experimenting and engaging all stakeholders
3. Funding should be used for measures that promote the development of the service ecosystem around a selected life-event or business activity. Such measures include e.g. coaching programmes and application development to enable the services to reach people and businesses in a timely, secure and ethical way.
4. An open Public-Private-People-Partnership (PPPP) process is implemented to invite all interested operators to contribute to the development of the service ecosystem. In particular, attention must be paid to ensuring continuous inclusion of the subject (individual or organisation) of the service ecosystem.
5. Innovative contracting, the alliance model and innovation partnerships should be utilised in investments. Existing and published services should be utilised according to the principles of digitalisation.
6. Management should be impact-driven. The focus of management should be on impact delivered for customers instead of monitoring individual service transactions.
7. Sandboxes should be created and utilised to promote an experimentation culture and support experimentation relating to legislation, technologies and other innovations. The key organisation should create an environment in which all ecosystem operators can participate in experiments.
8. Service referral should be facilitated without the need for strong authentication and sensitive data. Anonymous service referrals should be facilitated.
9. The development and implementation of experiments that require strong authentication and sensitive data should be made possible within the constraints of law and data protection. Individual legislative experiments should be prepared in cooperation with the implementation support team.
10. The anchor organisation is responsible for the platform ownership, the openness of technology, competitive neutrality and avoidance of lock-in situations during the experimentation stage in cooperation with the implementation support team.

Population Register Centre's tasks in AuroraAI

The Population Register Centre is responsible for promoting societal digitalisation and producing and developing electronic services for citizens, the public sector and businesses. In addition, it provides information management expertise in the public sector and promotes privacy, data protection, data security and the development of good information management practices. The Population Register Centre implemented the first trial version as part of the preliminary study project on AuroraAI.
Scheduled for launch in 2020, the Digital and Population Data Services Agency is a national authority responsible for promoting digitalisation and providing life-event-based services. The Digital and Population Data Services Agency will steer and advise the whole public administration sector in the digital implementation of services. In particular, the agency's operations will focus on national procedures, common practices and the opportunities of digital operations.

The Population Register Centre also maintains core services required by AuroraAI, including service directories, natural language analysis (intention recognition) and authorisations. The centre ensures that operators who join the ecosystem commit to the necessary requirements.

The centre supports and coordinates the establishment and development of the AuroraAI network and provides situational intelligence for the service ecosystems at various levels and in connection with different types of life-events and circumstances. The centre is the coordinating authority responsible for the central administration of AuroraAI.

The centre has five primary tasks in AuroraAI:

1. Responsible for the establishment of the AuroraAI service architecture
2. Responsible for the development and production of AuroraAI core services
3. Provides technological support for joining organisations and services
4. Responsible for the AuroraAI connection agreements
5. Produces situational data for the AuroraAI network
6. Provides support on the use of the interoperability platform

Establishment of the AuroraAI service architecture

The Population Register Centre is responsible for the planning and implementation of the AuroraAI service architecture. It includes e.g. the service model, the functionalities of core services such as service directories, authorisation, log and reporting functionalities, consent management functionalities and their centralised or decentralised production models as applicable. In addition, the service architecture includes the planning and implementation of services and processes that are needed to generate situational data for purposes such as technical and administrative reporting or the reporting of ecosystem business data.

In addition, the Population Register Centre produces mechanisms for the implementation of data protection (GDPR), the accessibility directive, data security standards and ethical operating principles, and the associated design tools, guidelines and, if applicable, auditing mechanisms. The design tools include guidelines for the delivery of consistent user experiences and the ethical guidelines and mechanisms to ensure commitment to the guidelines.

Development and production of AuroraAI core services

AuroraAI core services to be developed and implemented by the Population Register Centre include service directories, end-user intention recognition services, centralised or decentralised user management, log, access control and monitoring services, or, for example, repository and analytics services needed for reporting purposes. The implementations will be based on centralised electronic support services whose development and administration are currently the centre's responsibilities, e.g. the Suomi.fi service repository, which will be extended to include the data of the AuroraAI service ecosystems. In addition, the centre maintains the Interoperability Platform (www.yhteentoimiva.suomi.fi), which is intended to serve as a national master repository for linked government data. The platform facilitates the semantic interoperability of datasets, which ensures the integrity of data as it is moved around.

The centre maintains an AuroraAI practice environment and develops open source solutions for the government, including for purposes such as chatbot implementation or the management of end-users' MyData to accelerate the large-scale joining of government services to Aurora and deliver cost-efficiency.

Support team for organisations and ecosystems joining the AuroraAI network

A support team will be resourced within the Population Register Centre to support organisations and ecosystems on questions relating to technical, administrative, ethical and legal matters as they join the AuroraAI network. The team will be responsible for the development and oversight of the AuroraAI service architecture, and it will actively work with stakeholders and contribute practical knowledge and realism to e.g. experiments carried out regionally.

AuroraAI connection agreements

Some of the services of the AuroraAI network require a connection agreement or licence. These include e.g. ecosystem-specific situational data services, and consent management and MyData core services. The purpose of the agreements and licences is to ensure that the parties are aware of and commit to their obligations relating to e.g. legal requirements and ethical principles.

Situational data of the AuroraAI network and service ecosystems

The Population Register Centre maintains and reports situational data relating to the connected service ecosystems, operators, services, interfaces and their utilisation ratios. All operators can access the same anonymised datasets, but the contribution and view of each operator may vary according to need.

Life-event pilots – lessons learned

Case: Moving to a place of study

The “Moving to a place of study” work package was implemented by the City of Tampere and the City of Turku. Expert assistance was provided by Gofore Oyj, Osaamisbotti Oy and Opiskelijan Tampere ry.

The work was carried out as part of the development of customer account and service management and vision work for the future of local government. The work was implemented in extensive internal and external networks of the city authorities. The experiences from this work package highlight the importance of customer focus, i.e. the centring of the customer in the development work by analysing the customer’s situation and needs from data. It is essential that customers’ information and service requests can be facilitated, accelerated and automated by technologies that customers find easy to use and which offer visible added value compared to the current service structure.

The task was to create human-centric information management models that facilitate
1. cross-sectoral co-management of the “moving to a place of study” life-event in Tampere and Turku.

2. The implementation of the Aurora network for the “moving to a place of study” life-event in Tampere and Turku.

The aim was to create:

1. A co-operation and co-management model based on the life event
2. A co-management information model based on a student customer’s 360 situational data
3. An advice bot trial for the Aurora network
4. An implementation plan for 2019–2023

The “moving to a place of study” work package highlighted some questions about the future role of city authorities. The management and use of customer data and service data grew in importance during the trial. The use of advanced analytics and artificial intelligence would enable city authorities to have a better understanding of citizens’ welfare status and the region’s vitality. Where increasingly diverse changes in the operating environment exacerbate issues that are linked to urbanisation, advanced analytics can offer tools for resolving complex problems. The work produced the following insights and lessons learned about the reasons and ways in which local authorities should be involved in human-centric change towards the life-event approach:

The life-event cooperation and co-management model was trialled based on a student customer’s 360 situational data (the Stiglitz model). The two cities carried out an extensive well-being survey among the student populations based on the Stiglitz model. Based on the survey results, students were clustered into groups, and factors supporting/affecting their well-being were assessed. The survey findings provided insight into the roles and tasks of different operators in students’ well-being. Before the survey, local authority operators were assumed to play a small role in students’ life. However, the results show that factors such as safety and security, public transport, the city environment and infrastructure and services such as recycling facilities all play an important role.

In Tampere, a series of management change workshops were implemented to discuss the results and review assumptions about students’ situation. A new analysis of the data was then carried out to gain further insights about the situation. In Turku, operations, services and management practices can be examined from the life-event perspective to support the city’s established “Student City” programme. The city authority and the region’s higher education institutions work with stakeholders to implement jointly-resourced measures, for which the life-event approach provides a common structure and enables network management.

Registers were mapped for the co-management information model; these include student-related information held by city authorities as well as other authorities (Tampere and Turku). The study also examined the possibility of city authorities joining the Koski register, which also contains student information (Turku). This study is still under way at the education department. Situational data retrieved from the registers can be used either as the basis or as supplementary information for 360 situational awareness.

The work package included bot trials for services, which were identified as key services for students based on input received from the student networks and 360 situational data. In Tampere, an advice bot was published on the website of Opiskelijan Tampere ry in

cooperation with Osaamisbotti Oy. The experience showed that online visibility and separate marketing were needed to get users to access the service. The aim was to add answers to the bot about topics which students found important. In Turku, the bot trial was based on information collected from the university networks. The first beta version was published in the Aurora network in week 8. In March 2019, the City of Turku will publish the bot output on its "Student City" web pages in order to get feedback and plan its further development.

In both cities, the technology trials highlighted the importance of developing AI competencies among city officials and developers. A training series on data analytics and AI was organised in cooperation with Gofore; it also served as an opportunity to disseminate information about the development of Aurora. Another message was the importance of re-examining the competence development of city authorities from the point of view of the new skill requirements (awareness of the customer perspective and needs; analytics and AI).

The implementation plan was prepared as part of management workshops in Tampere. Participants were encouraged to identify a customer group or service in their sector that would benefit from the life-event approach. Discussion topics included management in different types of operating environments, the history of management theories, and the future of management. Other topics included change management, the information model and the changing role of local authorities. Topics highlighted by the participants included the mobility ecosystem, the 'young family' years as a life event, the situation of school-leavers who are at risk of marginalisation, the safety of children's mobility and living environments, and changes in senior citizens' service structure. Life events are based on the same structure as in the preliminary study stage.

Life event	Impact target	Ecosystem operators
Impact of railways on mobility: Reducing welfare disparities between residential areas.	How can urban segregation be prevented? Sustainable development.	Urban environment services, Welfare services, alliances, businesses, third sector, users.
Marginalisation prevention in comprehensive and secondary education.	The well-being of young people and families. Reducing welfare disparities between residential areas.	Welfare services, Vitality and competitiveness services, schools, educational institutions, families, parent associations, recreational activities, young people.
Change in senior citizens' service structure.	Proactive and enhanced targeting of services to prevent social malaise, excessive services and the costs of specialised care. Senior citizens' quality of life, cost management.	Welfare services, Vitality and competitiveness services, Urban environment services, senior citizens, field-specific businesses and NGOs.
The 'young family' years: Safety and convenience in the lives of children with hobbies.	Children's well-being, families' well-being, Active from a young age, safe mobility, ecological urban structure.	Welfare services, Vitality and competitiveness services, schools, educational institutions, families, parent associations, recreational activities, children and young people.

Figure 12. Proposed life-events, which local authorities can join in the implementation stage of Aurora.

Case: Gaining a foothold in working life through competence development

People continuously need new skills during their careers, and there is a range of digital learning and employment services available. It can be difficult to identify suitable services from the vast selection. Advice on continuous learning and personal career paths is limited. In the “Gaining a foothold in working life through competence development” trial, information was collected and produced about various alternatives for using AI in the context of lifelong learning and employment, taking into account responsibility and ethical questions.

Solutions were developed by using service design, user consultations and collaborative brainstorming. Openness and information-sharing underpinned the work of the extensive network. The trial network partners included representatives from the National Agency for Education, the Ministry of Education and Culture, the Ministry of Employment and the Economy, and the following enterprises: Osaamisbotti, Headai, Accenture, Fjord and Suomen Tilaajavastuu Oy. In addition, development was assisted by students, learning and employment experts from various sectors, and the AuroraAI developer community.

The trial implementation stage included mapping the existing digital services for learning and competence development and a related fact-finding exercise (in three languages: Finnish, Swedish and English). Service providers can register their service and browse services at https://up5.hci.fi/digipalvelut/. In addition, a study was carried out on identity management in lifelong learning. Three options were presented along with ideas on how they could be tested. A user-oriented/human-centric model is needed, which separates between identity-merging, consent management and information-sharing.

Use of AI in the trial

The study and trials increased awareness of the ways in which AI could be utilised in an ethical way in the context of learning, competence development and employment. Smart digital services and related service chains can help users analyse their competencies and possibilities for competence development and employment.

Young people especially can find it difficult to articulate their skills, and the trialled chatbot, which facilitates discussion-based profile development, was found to be an effective way to identify personal interests and motivations that could otherwise be difficult to unearth. Potential uses for AI were identified, in particular, in calculation.

The solution produced in the trial maps the user’s competencies and compares them with existing educational and job offerings. The comparison requires data retrieved from various sectors, and the usability and quality of the service depend on the availability of data. In the

trial, information-sharing between service providers helped to enrich their data, and the developers were able to improve the quality of the solution based on reciprocal feedback. The developers were unable to implement information-sharing between authorities and service providers, and it was therefore not possible to determine how their interaction could enrich data. Nevertheless, the need for two-way flow of data was identified, and it is important to ensure that data held by the public sector can also be enriched in the future.

The following service path and measures were implemented in the trial:

1) Identification of keywords used in job adverts from a competence description written in natural language. The profile can be updated continuously. The profile is not validated. The user participates for personal development reasons and does not benefit from providing false information. In any case, it is assumed that in a trial setting no one is motivated to provide false information, as users are participating out of curiosity and willingness to experiment.
2) The competence profiles are used to search for matching job opportunities (all public job adverts published by TE Offices from the beginning of 2018, n>400,000), and each recommendation includes details of the relevant skills. The recommendations are based on information that is relevant to the user (not 'black box'), especially if the reason for the recommendation is not obvious.
3) In addition, competencies which the user lacks or has not described are highlighted (continuous iterative updating of the profile)
4) For any missing competencies, training opportunities are suggested (UAS institutions, training provided via TE Offices), and users can add competencies acquired through additional learning.

The technical implementation by Osaamisbotti and Headai proceeded without problems. Users were able to create a personal profile including competencies, job-matching and training opportunities to address skill gaps. Almost all observed and/or interviewed users (with one exception, described below) were able to find suitable job and educational opportunities. The outcomes were not assessed quantitatively; the following development suggestions and solutions are based on qualitative data (observations and interviews).

i) More attention should be paid to data transfer and authorisation principles, and their descriptions. In this trial, all data operations were implemented based on MyData principles and user consents. The consent question "Headai would like to use your data, do you consent" confused some users. Although the participants mostly understood that the trial was designed to explore data consent principles, they were understandably concerned about the potential sale of data (see Facebook and Cambridge Analytica). In the future, trust networks should promote trust between users and operators by providing detailed descriptions of data transfer and data uses so as to avoid being perceived as untrustworthy.

ii) Competence descriptions that were too generic, such as "sales", "customer service", "projects", "management" produced equally generic job suggestions. If the user had listed too many generic skills and fewer specific skills, the AI was unable to provide specific suggestions. Headai has an established scientific calculation component, which solves this problem by using a semantic-weighted deep network. The calculation time is a challenge, as it grows exponentially in line with the text volume to be processed. The calculation solution will be

implemented in 2019 by increasing the calculation capacity and developing solutions that accelerate the process.

iii) The AI recommended jobs on a “best skills-matching” basis. As a result, an experienced metal worker who also has management experience is offered manual jobs, since the skills match is 100%. Some users reported that they did not feel that the AI valued their skills, because it suggested jobs with a wrong seniority level.

Although this problem can be solved by assigning “management” as a competence, it creates another problem in terms of job relevance. For example, management experience in the metal industry could produce hits in IT management (based on a skill set of management, projects, processes, supervision), which may result in a poorer user experience. In addition, since management role suggestions are based on current skills, a user who has line manager experience but lacks certain skills will only see a 70% relevance for management roles in their field.

Although an optimal solution to this problem cannot be identified based on the trial, insights about the practical challenges are nevertheless valuable. The above observation may seem obvious in hindsight, but it was not expected by the developer team.

iv) If a user has extensive skills in a range of areas, the competence description may not match any job adverts or the job market’s expectations (we are unable to provide an example because the competence profile in question is assumed to be so rare among the trial participants that the person in question could be identified from the information). In this case, the AI is unable to chain the competence profile and the language used in job adverts based purely on the text. Headai has a set of support calls, which the user could test to see which of their competencies are recognised in the job market. However, these tools were not provided during the trial, which is why the person in question was unable to find good matches.

In the future, these kinds of problems can be resolved by using job adverts in the formulation of competence profiles.

Guaranteed predictions are only possible in a linear, simple world. In a complex or chaotic world, experiments are needed to understand the phenomenon. In the future, a solution similar to the trialled prototype can become an everyday tool. The greatest benefit would come from continuous use, which would give the tool continuous feedback about the user’s choices and personal development, and enable it to learn and produce increasingly accurate suggestions about suitable job openings and competence development opportunities. However, continuous use would require the tool to become part of everyday life and lifelong learning.

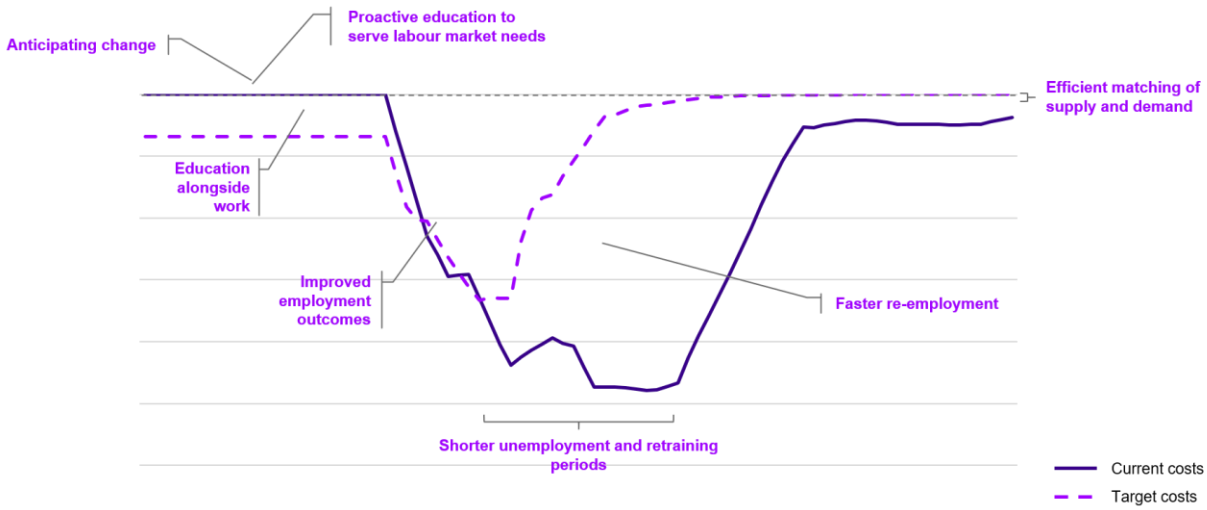

Figure 12. Competence and educational attainment levels should be improved and continuous learning should be facilitated. Some businesses and jobs will cease to exist and new jobs will be created in Finland in the next 10 years. This phenomenon can gain speed and increase the rate at which new skills are needed. Proactive service offering could lead to significant savings and support both individuals and businesses in the changing world of work.

There is some preliminary evidence about the scalability and benefits of the trialled solution in the context of learning and employment from the point of view of users and testers. More extensive and more frequently updated data flows from a range of operators are needed. In the long term, the solution and the personalised service offering it facilitates could help resolve the skills-matching problem as competence needs evolve.

Future possibilities

The referral and support services of the decentralised AuroraAI service network help me create a DigiMe profile and import my data from a range of sources (public and private sector services) and to articulate and verbalise my current skills and aims. The intelligent service chain mines and matches my profile data, futures data, foresight data and information about educational and job market offerings to help me analyse my competencies and job opportunities. I can also get information about my competence development needs and suitable opportunities so that I can address my skill gaps. I can access expert advice and guidance whenever I need it.

Case: The well-being of children and parents in changing family relationships

This preliminary study work package explored how changing family relationships (#divorcedfamilies) could be supported positively in an information society by using tools such as AI. The trials were selected based on the desired change in the general trend relating to

this life event, which is described below. The aim was to bring about a shift away from the winners/losers approach and towards supporting the family's wellbeing as a whole and empowering the family members. In addition, the aim was to facilitate continuous and amicable co-parenting. The idea was to develop families' understanding of what separation entails and what services are available to them and support the wellbeing of the family as a whole by addressing the needs of all family members. The table contains a summary of the trials carried out during the preliminary study and the discovered opportunities, findings and outputs.

Problem	**Trial**	**Opportunities, findings and outputs**
How can families be supported so that they know what to expect? How could each family member find a service that is appropriate for them? How to support amicable separation?	In the trial, a **set of 5 smart services** that complemented each other was implemented, ranging from a simple advice bot to a more targeted AI-based advice bot. Each bot was assigned a specific task area (e.g. a terminology bot).	Ability to implement **intelligent and well-targeted anonymous advice services.** Ability to implement **AI-assisted tailored and targeted advice services** based on the user's consent. A life-event definition for **independent bot architecture.**
How to develop and offer services that respond to people's needs in this life event?	A management-by-information trial was implemented in Ostrobothnia (the Vaasa region) by creating **situational data** about the situations of families with young children based on survey data and population information data. The data can be used to create various visualised situational datasets that can be used as evidence to support or discount assumptions.	Situational data provides **new insights for management.** The use of **situational data** requires dialogue and shared interpretations between all stakeholders of the life event in question. Situational data enables service offerings to be designed based on the needs of the group in question by showing which services are problematic and which ones work well. In addition, people can use situational data to serve their individual needs.
How to get all stakeholders in this life-event to develop and work together?	The "well-being of children and parents in changing family relationships" **package was implemented with a network-based approach by expanding the network throughout the project**. The project had participants from 19 organisations (service providers, researchers, businesses, NGOs).	**The network** should be created and administered by **a responsible operator**. The network must have a shared language, a good understanding of each participant's expertise, and a set of shared objectives. The establishment of such a network takes time. The development of the life-event requires an extensive partner network.

		Each participant should be allowed to contribute according to ability. The inclusion of people undergoing the life-event in question is important.

The following challenges were identified:

1. Current legislation prevents the sharing of data held by authorities to individuals themselves in a way that offers added value
2. Current legislation blocks the flow of information between organisations and to shared uses
3. Impact assessment relating to data protection in network-based co-development activity. The majority of services are produced by local authorities, which can operate independently. Which body will assume lead responsibility?

Case: Preliminary study stage: research on incentive models and smart tokens in the Aurora network

As part of the preliminary study project, a research project was carried out at the University of Jyväskylä blockchain laboratory to investigate possible uses and advantages of the open blockchain technology and cryptographically authenticated smart tokens in the context of service value chains and ecosystems relating to life-events in the Aurora network.

In ecosystems that are based on open blockchain technology and smart tokens, the distribution of value between the operators is controlled by protocol layer solutions and smart contracts. The development of value distribution mechanisms for the protocol layer, the formulation of smart contracts and the management of continuous development present challenges, for example, because the distributed data contains economic value and trade secrets and confidential information relating to the services. Therefore a crucial feature of successful open ecosystems is their ability to respond to the evolving challenges of network management. Open and agile ecosystems that are well managed will have a competitive advantage. In terms of the Aurora network, the developers must be able to create economic structures that are similar to ownership and encourage innovation and continuous development in the parts of the network in which (or for which) value is produced. In addition, new ways must be identified to fund organisations and encourage individuals and teams who are involved in innovation processes to instigate change in the practices and culture of their organisation. A key finding of the preliminary study project was that the above challenges could be resolved by smart tokens and smart contracts.

However, the token researchers concluded that, because the technology is still relatively primitive and entails issues relating to value distribution (described above), the AuroraAI network is currently too complex for a single open blockchain system. Open blockchain

systems could be beneficial, but they should be investigated and tested in smaller systems first.

Case: Preliminary study project: the ethics

The aim of the ethics project was to examine major ethical questions relating to the Aurora concept, determine the starting points for a common ethical code, and determine what further measures are needed in this area. In particular, Aurora poses ethical questions in areas such as data access permitting, consent management and processing, personal forecast data, service recommendations and advice, the creation and data security of personal compilation profiles, the transparency of AI, and citizen competencies and equality. At the universal level, all these questions are relevant from the point of view of responsibility and how it is allocated to different operators in the Aurora architecture.

Initial conclusions about the ethical questions relating to the Aurora service model were collated into a first draft document last autumn. The team reviewed international ethical guidelines and declarations relating to AI, and their principles were integrated into subsequent versions of the document.

The team then carried out a review of national legislation and applicable international treaties. The legal and treaty framework of Aurora was defined as follows: the Constitution of Finland, laws on public administration (e.g. the Act on the Openness of Government Activities), the GDPR and the Data Protection Act, the Non-Discrimination Act, the Act on Equality Between Women and Men, the Information Management Act, and international treaties and agreements providing for the protection and autonomy of individuals which Finland has ratified. A number of questions arose about the interpretation and application of these legal instruments in the context of AI and Aurora.

The first drafts of the AuroraAI ethical code and a proposal for the ethics programme were produced in late October. The proposal was presented to the DigiNyt steering group on 20 November 2018; the group did not suggest any amendments, and the proposal was also published on the Slack channel of the network partners. The document was then supplemented and reviewed based on expert meetings, seminars and workshops implemented in autumn.

In November and December, the Suomi.fi user community (approx. 130 users) were invited to comment on the AuroraAI service model based on the model description and an extensive questionnaire. The responses again highlighted the importance of citizens' inclusion, as found by the ethics inquiry.

Potential ethical issues were identified in workshops organised with the life-event work package teams in December. In January, an ethics workshop was organised with data protection lawyers from the relevant ministries and agencies and experts working on the life-event pilots. The workshop participants reviewed key ethical questions from the point of view of data protection and information management. Two further workshops were organised in January and February. Feedback was also sought from the FCAI society (network of AI

researchers from Finnish universities) in a conference on the Aurora service model in January. In addition, specialists from the Non-Discrimination Ombudsman's Office were consulted.

The work concluded with the formulation of a preliminary ethical code for AuroraAI and the definition of work packages to ensure its legality and ethical integrity. The recommendations document places emphasis on the legality of AI development and AI-based services, clear ownerships and responsibilities, transparency, users' inclusion in the design process, ethical impact assessments carried out before implementations, the development of AI competencies, and technological security and sustainability. Critical areas requiring legal work to facilitate the progress of Aurora were identified, alongside the need to establish a clear set of rules to ensure its ethicality.

The AuroraAI service model should be seen as one part of AI-based digitalisation; the relationships and roles of public administration, public and private service providers and citizens will change as part of this process. It is therefore recommended that a cross-sectoral and multidisciplinary expert group or committee on AI and ethics be set up and authorised to monitor the development and issue related guidelines and recommendations.