

A short professional biography of Eero Hyvönen

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Start of artificial intelligence research in Finland

Eero Hyvönen graduated from Helsinki Normal Lyceum in 1976, finished his Master of Science in Technology thesis in 1981 with the subject of applying graph grammar to word processing, and continued researching the topic in his licentiate thesis in 1984 on understanding the natural Finnish language (Hyvönen, 1984). In the same year, together with Jouko Seppänen and Markku Syrjänen, he organized Finland's 1st Artificial Intelligence Research Symposium (Hyvönen et al., 1984acb) STeP at the Helsinki University of Technology (TKK). STeP conferences later developed into the longest regularly organized information technology conference series in Finland. The funding collected by the conference was used in 1986 to establish the Finnish Society for Artificial Intelligence (STeS), of which Hyvönen was a board member and chairman for several years. Interest in Artificial Intelligence was at its peak in the 80s also in industry, and Hyvönen worked as a part-time consultant and trainer, e.g., at Nokia Data Ltd, which started the import of Lisp machines developed for artificial intelligence. Hyvönen also completed his military service in special tasks related to Artificial Intelligence and has the military rank of second lieutenant.

In the 1990s, a large interdisciplinary community was born within STeS to promote research and teaching in various fields. Hyvönen wrote the first Finnish-language textbook on artificial intelligence expert systems and technologies (Hyvönen, 1985) and two works on artificial intelligence programming (Hyvönen and Seppänen, 1986, 1987), which were also translated into Russian by an Estonian academician. Under Hyvönen's leadership, the first comprehensive overview of artificial intelligence in Finnish, *Encyclopedia of Artificial Intelligence* (Hyvönen et al., 1993), was edited. In addition, he was involved in book projects within the framework of STeS, promoting, e.g., research on the philosophy and history of artificial intelligence (Haaparanta et al., 1995; Hyvönen, 2001) and artificial life (Hyvönen and Seppänen, 1995).

Promotion of software business

After moving to a research position at the Technical Research Center of Finland (VTT) in 1987, Hyvönen began researching the use of artificial intelligence constraint reasoning in mathematical and logical problem solving, on which he published a doctoral thesis in 1991 (Hyvönen, 1991, 1993) after a research visit to Japan's ETL research center as a STA Fellow. To commercialize the methods and software developed in the dissertation, the start-up company Delisoft Ltd was founded at VTT, and Hyvönen became the CEO in 1997. At the same time, Hyvönen started to promote the development of the software business in Finland and served for several years as a board member of the Software Finland association. In 1999, Hyvönen was invited as a professor at the Department of Computer Science at the University of Helsinki, where he taught, e.g., software business. In connection with this, he edited the first Finnish textbook on software business (Hyvönen, 2003).

The development of the Semantic Web starts

The international development of the Semantic Web on a global scale started in earnest by the W3C organization in 2001 after the article by Tim Berners-Lee, James Hendler, and Ora Lassila published in *Scientific American*. Inspired by this new field of research related to artificial intelligence, Hyvönen

organized the 1st conference in the field in Finland "Semantic Web Kick-off in Finland" in cooperation with, e.g., with W3C researchers and the Finnish Society for Artificial Intelligence (Hyvönen 2002). After the conference, Hyvönen founded the Semantic Computing Research Group (SeCo) (<https://seco.cs.aalto.fi/>) operating at the University of Technology (Aalto University) and the University of Helsinki, whose first semantic web research projects started in 2002. In 2005, a new professorship focusing on the Semantic Web was established at the University of Technology (Aalto), to which Hyvönen moved from the University of Helsinki. However, his and the SeCo group's activities have continued to be active at both universities even after this. Since 2001, Eero Hyvönen and the SeCo group have organized approx. 40 open seminars, public announcements and other events related to semantic web technologies (<https://seco.cs.aalto.fi/events/>).

Creation of a national ontology infrastructure

The ambitious goal of the SeCo group led by Hyvönen has been the systematic construction of the national semantic web information infrastructure in Finland in such a way that it is interoperable with international semantic web standards (W3C) and best practices (Hyvönen et al., 2008, Hyvönen 2023b). The work began on a large scale in 2003 as a series of ten-year FinnONTO projects, which were financed by the Finnish Funding Agency for Technology and Innovation Tekes and a total of some 50 Finnish public organizations and companies. As a result of the project, key ontologies were created from subject vocabularies in use in Finland (Seppälä, Hyvönen, 2014) and, to utilize these, the ONKI.fi ontology service concept and service (Tuominen et al., 2009) was published for trial use online in 2008. The ONKI.fi prototype was deployed by the National Library in 2014 to the currently widely used Finto.fi service (Suominen et al., 2014), whose application programming interface receives tens of millions requests every year.

The use of FinnONTO's ontology infrastructure was studied and applied in numerous application projects, such as the TerveSuomi.fi service produced by the Institute of Health and Welfare (THL), and the early Sampo portals in the cultural sector Kirjasampo.fi and Kulttuurisampo.fi, where, e.g., the national epic Kalevala was transformed into a semantic network "understood" by the computer.

Development of a linked open data infrastructure

Inspired by the results of FinnONTO, the focus of Hyvönen's research in the development of the national information infrastructure expanded from ontologies to Linked Open Data, data services and semantic portals. The work started as two consecutive Linked Data Finland projects with the support of Tekes and a wide range of Finnish organizations in the same vein as the FinnONTO project series. One key result of this work was the creation of the Linked Data Finland platform LDF.fi as a service equivalent to the ONKI ontology service, which enables the publication of linked data for researchers and application developers to use. LDF.fi's service concept generalizes the so-called the five-star publication model (5-star model), coined by the father of the Web Tim Berners-Lee, into a seven-star model (Hyvönen et al., 2014). The LDF.fi platform has been actively used as a data service for the Finnish Sampo systems (more on that below) and is part of the current national digital humanities FIN-CLARIAH data infrastructure funded by the Academy of Finland.

Sampo model, data services and semantic ladders

The LDF.fi data service and ONKI/Finto ontology services form the core of the Finnish Semantic Web infrastructure, which the SeCo group aimed for (Hyvönen, 2023a). In order to test and demonstrate the usability of the infrastructure, the SeCo group has been developing linked open data services in various fields of research and publishing portal applications based on them since 2002. From the experiences gained at this work, the so-called "Sampo model" has gradually evolved with some twenty

Sampo data services and portals published on the Semantic Web (Hyvönen, 2023b). For example: MuseumFinland (National Museum and other museum collections), CuUltureSampo (various museum, archive and library materials), WarSampo, WarVictimSampo 1914-1922 and WarMemoirSampo (National Archives, Defense Forces, National Survey, and others), NameSampo (Kotus place name archives and National Survey place name register), MMM Sampo (medieval and Renaissance manuscripts from the University of Oxford, the Schoenberg Institute and the French IRHT research institute), BiographySampo (National Biography of the Finnish Literature Society and other biographies), AcademySampo (Finnish academics 1640-1899), LetterSampo (pre-modern correspondences from numerous European archives, such as from the University of Oxford), FindSampo (Archaeological finds of the Finnish Heritage Agency), and ongoing project Finnish LetterSampo (domestic correspondences from various archives during the period of Russian rule), OperaSampo (database of Finnish musical performances of the Sibelius Academy 1830-1960), CoinSampo (numismatic collections of the British Museum and the National Museum), ConfermentSampo (University of Helsinki traditions) and ArtSampo (collections of the National Gallery and Finnish art museums). In the spring of 2023, ParliamentSampo.fi was published, which for the first time allows one to search and analyze all the approximately one million speeches given in the Parliament of Finland since 1907 and study the networks of more than 2,800 Members of Parliament. Similarly, the LawSampo.fi service, which publishes Finnish legislation and legal cases, was opened in cooperation with the Ministry of Justice.

Many Sampos have become popular services not only among researchers but also among the general public: The Kirjasampo.fi service, deployed and maintained by public libraries since 2011, had an estimated 1.6 million users in 2022. WarSampo, which publishes the history of World War II, has had more than one million users and BiographySampo more than 380,000 users. Other Sampos have typically had tens of thousands or at least thousands of users (Hyvönen, 2023b).

In 2012, Morgan & Claypool, operating in Palo Alto, USA, published Hyvönen's semantic web technologies in the field of culture, the first textbook in the field (Hyvönen, 2012) and in 2018 Gaudeamus published the field's 1st textbook in Finnish, "Semantic Web – Handbook for Linked Open Data" (Hyvönen, 2018). Over the years, Hyvönen has published more than 500 research articles and books pertaining to the works described above, and with his research groups has received 25 international and domestic awards. For example, he has got the Semantic Web Challenge Award of the field's research community twice, UNESCO/UNIDA's World Summit Award, and the LODLAM Summit Open Data Price, and in Finland the Prime Minister's innovation award, Finland's Artificial Intelligence Society's medal of honor, Aalto SCI Scientific Communication Award and the State Award for Public Information.

Hyvönen has held many international positions, such as program committee and chair positions of dozens of conferences, editorial boards of four scientific journals, expert groups of EU and the European University Association (EUA), scientific steering group memberships of research programs and projects (Germany, Netherlands, Great Britain, Sweden) and evaluation committees. For example, in 2021 he was invited to the expert group to evaluate the computer science departments in the Netherlands and to an EU Commission's expert group, whose report (Brunet et al., 2022) launched the extensive pan-European development program European Collaborative Cloud for Cultural Heritage (ECCCH) in 2023.

Digital humanities research and establishment of the HELDIG center

In the 2010s, the research at the SeCo group was increasingly oriented towards cultural heritage applications and digital humanities. In 2015, the idea of establishing a digital humanities center "HELDIG" with eight new professorships in the field was born within six faculties of the University of Helsinki. This initiative was funded in the Profi program of the Academy of Finland, receiving a total of approx.

10 million euros in funding in 2016, and Eero Hyvönen from Aalto University was invited to head the center. The founding of HELDIG and the networks it created have been a significant boost to research in the Digital Humanities, not only at the University of Helsinki, where, e.g., new Department Digital Humanities was established, but also more widely in Finland and internationally (Hyvönen, 2021). The development in Finland has now led to, e.g., to the extensive digital humanities infrastructure project FIN-CLARIAH covering all Finnish universities on the national research road map of the Academy of Finland. FIN-CLARIAH includes also the linked open data services and the Sampo systems of the of the SeCo group.

Summary

Eero Hyvönen has been promoting the start of research and teaching in Artificial Intelligence and related interdisciplinary fields in Finland by publishing the first textbooks in the fields, organizing dozens of conferences and other events, and through his own research work. During the last twenty years (2001-), the ambitious goal of his and his Semantic Computing research group's research has been the development of a national, Finnish-based semantic web ontology and information infrastructure in Finland in cooperation with dozens of Finnish public organizations and companies. The ontologies and ontology services developed in the national FinnONTO projects led by Hyvönen were deployed by the National Library into the current Finto.fi service, whose APIs today receive by tens of millions of requests every year. Based on the new data infrastructure, the group led by Hyvönen has created twenty so-called Sampo system in use based on the "Sampo model", especially in the field of digital humanities. In 2016, Hyvönen was invited as the director of the Helsinki Center for Digital Humanities (HELDIG) to initiate and promote Digital Humanities research in Finland and beyond. Sampo systems are used not only by researchers but also by the general public. For example, BookSampo, which is today maintained of public libraries of Finland, currently has approx. 1.6 million users per year. The Sotasampo.fi service, which publishes military historical materials from the National Archives, the Defense Forces, the Land Surveying Institute, etc., has been used by 1.1 million users, and BiographySampo, based on the biographies of the National Biography of the Finnish Literature Society, has been used by over 380,000 users. Other sambos have had tens of thousands or at least thousands of users. In the spring of 2023, ParliamentSampo.fi, based on the materials of the Parliament of Finland, was published, which for the first time publishes all the million speeches given in the Parliament as well as the networks of the parliamentarians since 1907. Also LawSampo.fi was published, developed with the Ministry of Justice, to publish up-to-date Finnish legislation and legal cases openly on the Semantic Web. Hyvönen has received 25 recognitions for his work, such as the Semantic Web Challenge award of the international research community twice and the World Summit Award of UNESCO/UNIDA, as well as the Prime Minister's Innovation Award and the State Public Information Award in Finland. He has worked in numerous international and domestic organizations, editorial boards, steering groups, and positions of trust, and has published more than 500 scientific and technical articles and books of his research.

More information

Homepage: <https://seco.cs.aalto.fi/u/eahyvone/>

Publications online: <https://seco.cs.aalto.fi/u/eahyvone/publications/>

Curriculum Vitae: <https://seco.cs.aalto.fi/u/eahyvone/cv/>

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