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The Swedish knack for technology

Published by Newsroom Editor on 29/03/2012



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What do the names Celsius, Linnaeus, Pasche, Nobel, Ericsson, Zennström and Ek have in common? These famous innovators all hail from Sweden, a country of just 9 million people with a long history of inquiry and a proven ability to deliver significant scientific and technological breakthroughs.

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Being home to the Nobel Prize is more than a symbolic nod to great achievements in science and the humanities; Swedish ingenuity continues to drive progress in a range of fields, in particular information and communications technologies (ICT).

The meteoric rise of the music-streaming service Spotify is big news in the growing list of countries where the Swedish-founded company has launched since it kicked off in 2008. Spotify's founders Daniel Ek and Martin Lorentzon have shot to fame in the vanguard of European entrepreneurs of the Internet age.

These two innovators are joined by another Swede who is not only changing the tools we use to communicate, but also the language we speak while using them. Keep this in mind, next time someone says 'Skype me!' For the 10 people on the planet who don't know what this means, Skype is a system using voice-over-Internet protocol (VoIP) that allows people to make low-cost telephone calls via the web. The company was co-founded by Swedish-born Niklas Zennström and sold in 2011 to Microsoft, by which time it had around 700 million users.

Going back in time, we see communications technology could indeed be in the Swedish blood. Lars Magnus Ericsson (1846-1926) started the company bearing his name around a century ago. Today, it is one of the largest telecom companies in the world.

Meanwhile, earlier in the 19th century, Alfred Nobel put his great wealth towards creating the Nobel Prize reportedly to atone for the harm to the world that his most famous invention - dynamite - had

caused. Today's great scientists and thinkers are recognised with great ceremony in Sweden as the year's Nobel Laureates.

Further again in history, Carl Linnaeus' contribution to botany, zoology and even modern-day taxonomy is still being felt today. His binomial nomenclature (two-part names) for animal and plant species has helped create order in the natural world. Many also credit him as the father of ecology. And Anders Celsius was the astronomer who came up with the 100-point thermometer scale in the early 1700s, a system used across the world today.

This brief history of famous scientific Scandinavians is just a prelude to the Swedish pioneers of today. In academia, research labs and industry, Swedish researchers are pre-eminent in fields ranging from conservation sciences to cytogenetics; software development to Internet safety.

To this day, Sweden has one of the highest levels of public investment in research compared to the size of its population. According to ERAWatch, Swedish governments have tended to maintain public outlays for research at almost 1% of GDP. Add in private investment, and Sweden is one of the only two EU countries that has managed to surpass the target of 3% of GDP invested in R&D annually.

Show me the IT!

Swedish pragmatism and leadership is on show in the EU-funded [SHOWE-IT](#) [2] (1) pilot study aimed at reducing energy and water consumption in social housing in three locations: Rochdale (UK), St Etienne (FR) and Botkyrka (SE). Each of the initial 211 households chosen for the trial has been equipped with easy-to-use 'smart' meters and other ICT-based tools which will help them reach a target of 20% savings in energy and water consumption - a threshold for the SHOWE-IT approach to be considered commercial viability.

Meanwhile, the [BECA](#) [3] (2) project, which involves Swedish housing specialists ÖrebroBostäder AB, is taking the 'big picture' approach to domestic energy and water conservation across Europe. Social housing organisations in seven European countries (Bulgaria, Czech Republic, Germany, Italy, Serbia, Spain and Sweden) and their partners are cooperating in the project to provide ICT-based energy management and energy awareness services directly to around 5,000 social housing tenants and service operators. Following a year of investigation and prototypes, the three-year project is now entering an important operational phase and will conclude at the end of 2013.

Sweden is taking a leadership role in global efforts to make the Internet a safer place for young people. For example, the [Safer Internet Centre Sweden](#) [4] and related [Awareness Node](#) [5] scheme, as well as the Internet Safety Helpline, are keeping parent and student groups, governments, industry, associations and educators to informed of the latest trends and dangers young people face using online technologies.

Meanwhile, the [Robert](#) [6] (3) project is studying the tactics that Internet predators use to groom young people and using the findings to equip children, especially the more vulnerable ones, for their forays online. And the [FIVES](#) [7] (4) project is developing novel forensic techniques and tools tailored to help police investigate the vast amounts of evidence (videos and images) collected of child sex abuse cases.

'[Looking] for illegal images and videos or other investigative leads in the large amounts of data found on seized storage devices,' the project team explains. 'An average investigation could have several terabytes of data stored in different media and formats.'

The FIVES project, led by Karlstad University with support from NetClean Technologies Sweden AB, is

using perceptual optimisation techniques, object matching and image similarity techniques, among other methods, to allow details of crime scenes to be linked between different image sets or videos and lift the burden on investigators.

Healthy respect for technology

Swedish partners are also active in the field of eHealth, which supports wider eGovernment initiatives. Take for example, the EU-funded [Sustains](#) [8] (5) project which is trialling 'Electronic health record' (EHR) technologies in 11 pilots across nine European countries. The project is looking to empower patients and improve the overall quality of care for Europeans while making health care more efficient and cost-effective.

Meanwhile, the EU-supported [epSOS](#) [9] (6) pilot project is making it easier for people to receive medical assistance anywhere in the EU by removing linguistic, administrative and technical obstacles. According to the project's coordinator Fredrik Linden, of the Swedish Association of Local Authorities and Regions (SALAR), some 30,000 health professionals will use the new services developed (ePrescriptions and Patient Summaries) within the project.

Addressing the challenge of an ageing European population, Swedish researchers are also active in field of palliative care, seeking answers to the question: What can caregivers do during the final days of their patients' lives, apart from administer drugs?

According to Dr Olav Lindqvist of Sweden's Karolinska Institutet, 'Palliative care is all about satisfying fundamental human needs, but ... it entails so much more than one might at first assume. If we are to further develop palliative care, we must learn more about this type of daily care-giving and tease out its nuances.'

The research team, supported under the EU-funded [OPCARE9](#) [10] (7) project, analysed 16 palliative outpatient and inpatient clinics in nine countries. Nursing staff, doctors and volunteers from each clinic were all asked to record non-pharmacological activities that were carried out during the final days of a patient's life, for three to four weeks. The results were recently reported in the journal 'PloS Medicine' and promoted on CORDIS News.

A mercurial bug

The last example of Swedish ICT prowess, if further evidence is needed, comes from the recently concluded EU-funded project 'Property-based testing' ([Protest](#) [11]) which has developed cutting-edge software engineering approaches to improve the reliability of software systems. According to reports, the Protest team, which includes Swedish partners Ericsson, Quviq AB and Chalmers University of Technology, was able to find bugs in systems that had been used for years and, while they sometimes demonstrated strange behaviour, no previous tests could find the cause.

According to the EU Commission official in charge of the project, Protest has delivered an outstanding set of results: 'One of the best projects I have ever had.' And in true Swedish spirit the research will find its way into technological innovations which stand to improve industry and Europe's bottom line.

'Their tools will be used in the telecom industry (Ericsson) and also the car industry (Volvo) where they can test if software systems are functioning according to the Autosar standard,' according to the Commission.

Continued investment in skills and research capacities should help ensure that Sweden maintains its vital contribution to the European Research Area, with many more names to join the list of illustrious Swedish scientists. And perhaps someday soon, a Nobel laureate who will not have so far to travel to

attend the Stockholm ceremony honouring them!

The projects featured in this article have been supported by the Competitive and Innovation Programme's (CIP) ICT-Policy Support scheme or the Seventh Framework Programme (FP7) for research.

- (1) 'Real-life trial in social housing, of water and energy efficiency ICT services'
- (2) 'Balanced European conservation approach'
- (3) 'Risktaking online behaviour - Empowerment through research and training'
- (4) 'Forensic image and video examination support'
- (4) 'Support users to access information and services'
- (5) 'Smart open services - Open eHealth initiative for a European Large Scale Pilot of patient summary and electronic prescription'
- (6) 'A European collaboration to optimise research for the care of cancer patients in the last days of life'

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- Date: 2012-03-29
- Offer ID: 8320

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