The Finnish Engineering Award

1981–2018
Dear reader

As an institution, the Finnish Engineering Award has existed since 1981. The Award has gained a well-established position in the field and currently constitutes a prominent landmark for the Finnish operating environment.

The period in question has been truly exceptional - both from the Finnish and the global viewpoint alike. Over the past few decades, Finnish technology has stepped from mediocrity to the global forefront. Structural change in the ICT sector is currently causing problems that are hampering the country's technology-driven economic growth. There is an imminent need for new openings and future-oriented investments. However, it is obvious that the road to a better future will be built on technology, related expertise and competence. This recent experience strengthens the visionary statement recorded in the Award's decades-old charter of foundation: "Fast technology development has and will exert a profound impact on the status of Finnish society and the well-being of its citizens." The statement has lost none of its current interest from the time it was written and will certainly retain its validity over the coming years.

This means that the Award has retained its basic character over the past decades. The Finnish Engineering Award is granted collegially by the profession to acknowledge a notable innovation that has or is expected to promote the country's technology competence to a remarkable degree, providing a significant potential for commercial success in the global market. The assessment process focuses on examining the work and the achievements in question. The standard practice is to exclude the recipient's personal history, educational background and possible activity in organisational affairs from the assessment criteria. Almost all the works decorated with the Finnish Engineering Award fulfil the criteria of a genuine innovation, even with regards to the innovation's commercial exploitation. Over the past years, many awarded projects have generated significant industrial and economic activity. According to a modest estimate, these innovations have created the basis for thousands of new jobs in Finland. Some of the innovations have been directly convertible into commercial products while others have been exploited as a basis for further development or by entirely different sectors. Some of the works have been purchased by foreign investors. It is interesting to observe that, even in these cases, the results have primarily benefited Finnish society in particular. In a globalising operating environment, competence will play a superior role compared to ownership and any other factors involved. An increasing emphasis on the role of entrepreneurs is clearly seen in the Awards granted during this millennium.

We hope that the Award will continue to encourage and inspire people working in the field of technology, spurring them on in their long-term efforts to produce outstanding results. The awarded works constitute an interesting cross section of Finland's achievements in state-of-the-art technology in recent history. The innovations and people who have won the Finnish Engineering Award over the past decades are introduced by editor Lauri Lehtinen in his familiar style. The publication is also available as Finnish version. The publication and additional Award-related information is available in an electronic form on our website at www.tek.fi/en/finnish-engineering-award. A downloadable set of material on Award proposals for 2018 is also accessible at the same address.

Pekka Pellinen
Academic Engineers and Architects in Finland TEK
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Finding the correct solutions first
The first Finnish Engineering Award was granted to Martti Harmoinen who developed the first Finnish frequency converters. With his team he was able to make the right choices a couple of years ahead of all other designers in the world.

A frequency converter is a device that can be used to control the oscillation rate of alternating current. Frequency converters enable the stepless changing of AC motors’ rotation rates, thus providing the possibility of saving huge amounts of energy.

The equipment manufactured at Pitäjänmäki alone reduces emissions by about as much as the total produced by a city as large as Berlin (population 3 million).

From the underground to the global market
Building the Helsinki underground train system provided an excellent opportunity to prove the applicability of frequency converters. The underground solutions that were developed directly generated a number of large-scale export contracts with the global market.

The Swedish-based ASEA Company acquired the Strömberg Company in the mid-1980s, which was shortly followed by a major company merger resulting in the current industrial conglomerate ABB. The high standard of the Finnish frequency converter expertise was expressed in ABB’s decision to transfer its associated product development to Finland in its entirety.

Long-term success
In 1981, Strömberg’s total frequency converter sales amounted to about 5 million euros – a considerable sum of money. The current annual sales of the Pitäjänmäki frequency converter factory in Helsinki are 50 times higher amounting to an average of over 250 000 000 euros. Production employs about 700 personnel.

At all times, the sales have been export-driven, with about 90% of current production sold directly to the export market, plus a considerable share of the equipment that is sold to the domestic market ending up outside Finland through large-scale export projects.

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Underground train technology
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The basic construction of an AC motor is very simple, which means that its production and maintenance costs are only a fraction of the comparable DC drive costs. Before the advent of frequency converters, the use of DC voltage was the only solution, provided that rotation rate control was required.

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Software development for radiosonde ground stations

Ilkka Ikonen, Lic.Sc. (Tech.)

Vaisala – measuring upper air since 1936

Vaisala has become the undisputed world leader regarding equipment and instruments used for making and receiving meteorological observations from the upper atmosphere. The system consists of a balloon-borne radiosonde, a ground station that receives its data transmissions, and computer software that interprets the acquired measurement data. A radiosonde ascends into the upper atmosphere measuring the temperature, humidity, air pressure, wind speed and direction. Vaisala developed these three essential meteorological observation components – the radiosonde, the ground station and the observation software – into a single entity that became a commercial success throughout the global market. In 1982, the Engineering Award was won by the Vaisala measuring system’s computer software. Vaisala did not gain success by chance but through determined work on a long-term basis. The company uses about 12 % of its annual turnover for research and development activities.

Currently, Vaisala’s upper air observation activities result in an annual turnover of about 76 million euros. Currently, Vaisala’s upper air observation activities result in an annual turnover of about 76 million euros. These activities employ roughly half of the company personnel or nearly 500 people. In addition, it must be pointed out that the company has outsourced a major portion of its production to subcontractors, which means that the resulting employment effect is considerably higher. The subcontractors are also partly responsible for methods and product development pertaining to their own expertise.

Vaisala develops and manufactures electronic measurement systems and equipment. The products’ application areas are meteorology, environmental sciences and industry. Vaisala’s market area covers the world in its entirety.

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Further whey processing technology

From a problematic waste to a valuable raw material
In 1983, the Finnish Engineering Award was granted to a series of inventions relating to the further processing of whey. These inventions greatly assisted the Finnish milk processing industry and have resulted in new infant formula products, among others.

The origin of this work dates back to the 1960s when a new Waste Water Act came into force. Cheese and milk production extracted whey, which constituted a problematic waste material for waste water treatment plants, due to its volume and quality.

Matti Heikonen, D.Sc. (Tech.) was assigned to solve this waste water problem. He soon realised that the only rational solution would be to totally eliminate the generation of this waste type by turning whey into a free raw material.

Finland produces several hundred million kilograms of whey per year. A number of new processes were developed to extract the proteins and lactose contained in it. These were based on novel techniques, such as the extraction of salts through ion replacement and electrodialysis, ultra filtering, and lactose hydrolysis.

Building the basis for the lactose industry
Matti Heikonen was well ahead of his international competitors in his work.

This provided the Finnish dairy industry with a competitive advantage that compensated for our long transportation distances.

A special feature of the dairy industry is that its turnover figures and raw material prices are high, with a low degree of processing. With regard to whey, the situation is the opposite – it is a free raw material with a relatively high value-added effect.

Currently, almost all the whey produced in Finland is further processed locally. This means a total turnover of several hundred thousand euros and employment for about 150 people.

Without the Heikonen Team’s development achievements, this money and work would have been drained away with waste water.

Further processing of whey has never been subsidised; instead, the resulting products are sold in free competition in the global market. At present, Finland exports more than 90% of its whey-based products.
High density pulp pumping technology

Pulp pumps spin billions

The use of centrifugal pumps in the transfer of medium density stock provided pulp mills with significant energy and maintenance cost savings throughout the world. At the same time, it reduced the pressure on mills’ environmental protection measures by a significant degree. At present, the sales of pumps and associated peripherals is a billion euro business. The centrifugal pump is by far the commonest pump type used by the industry. In principle, it contains only one moving part, resulting in low manufacturing and maintenance costs. In addition, it has a relatively low energy consumption level.

Medium density pulp contains about 8–20 % fibre, and is so solid that you can walk on it, in a storage tank, for example. Previously, it was believed that pulp transfer required piston-pump-type equipment, due to the fact that making pulp behave like a liquid had invariably failed.

The 1984 Engineering Award was based on a technology that turned pulp liquid and enabled the pumping of medium high stock using the centrifugal principle. This invention was a blockbuster and provided pulp mills with major savings.

The secret lies in the vortex

When exposed to a high-intensity vortex movement, paper stock starts behaving like a liquid. The MC pumps that were developed by Ahlström contained a number of essential insights, such as high shearing forces and turbulence. In addition, a degassing function was incorporated in the impeller, which made the stock more uniform and enhanced the effect of additive chemicals, among other things.

MC pumps were much smaller, simpler and cheaper than their predecessors. Furthermore, their maintenance requirements and maintenance costs were a mere 10% of the previous costs. Maintenance was carried out quickly, which reduced shutdown periods to the minimum. In addition, energy consumption decreased, especially with high densities.

Savings were also made in mill construction costs. The chemicals could be mixed in the pumps, which made separate mixing tanks obsolete. Stock discharge from a storage tank no longer required dilution, which reduced the volumes of water transferred and purified within a mill.

Still going strong

Some of the MC pump patents have already expired but there has been a steady flow of new patent applications. Product development has continued uninterrupted, and thousands of pumps and related equipment related to the circulation of medium density stock have been delivered to clients over the years.

These inventions have been of strategic importance to the Finnish pump industry, and to pulp production on a global scale. The handling of medium density stock flows has provided an outstanding contribution in solving the pulp and paper mills’ energy and environmental protection problems.
Electroluminence display

Flat panel display and several other inventions

Tuomo Suntola was granted the Engineering Award in 1985 for his inventions relating to a flat panel electroluminence (EL) display. These innovations have borne fruit in several fields and their greatest achievements may still be forthcoming.

Above all, electroluminence displays are used in applications where special display characteristics are required. The application areas include industrial equipment and devices used in medical technology, for example. Under these circumstances, the EL display’s wide view angle, good contrast and wide temperature range provide advantages that are hard to come by using other display technologies.

Among the advantages of the luminence display are its wide view angle and temperature tolerance. Currently, the global EL market leader is Planar Systems Inc., an American company, with its share of 60%. The company’s European business is run by Planar Systems Oy, based in Otaniemi, Espoo, Finland, employing about 250 personnel. The majority of the personnel work for the EL display production unit, with some personnel occupied in R&D activities, sales and marketing. On an annual level, the company’s sales amount to over 17 million euros, plus the internal sales within the Group of half of this amount.

ALE iacta est

In 1985, the Engineering Award was granted for the entire technology that enabled the conversion of the luminence phenomenon into commercial products. One of its basic pillars was the generation of atom-thick layers, ALE (Atomar Layer Epitaxy). It still continues to be a fundamental precondition for electroluminence display manufacture. Nevertheless, ALE has begun to have a life of its own. As a production technology, it has occupied a separate niche, even in the manufacture of conventional silicon-based integrated circuits.

At the same time, Atomar Layer Epitaxy has gained a significant foothold in research into chemical catalytic reactions.

Among the advantages of the luminence display are its wide view angle and temperature tolerance.
Developing the ACUTSCAN magnetic resonance imaging device

Descriptive magnetic field

In addition to X-rays and ultrasonography, magnetic imaging is one of the most accurate methods of obtaining specific information on the human body's internal functions, without adverse affects on the person being examined.

The Helsinki University Central Hospital started to use a Finnish magnetic imaging scanner prototype in 1982. This was one of the first five similar devices in clinical use on the global scale.

The device was initially designed to detect internal haemorrhaging, enabled by the fact that the magnetic resonance phenomenon is extremely sensitive to body tissue's water content. It also detects the water binding level of proteins, which changes in conjunction with infections and tumours.

Developing the Finnish Acutscan MRI scanner was based on a pioneering insight – instead of increasing the magnetic field intensity, the focus was placed on improving the detector sensitivity. This improved the scanner's location detection sensitivity so tissue-related changes could be perceived more accurately.

At present, local MRI scanner production employs 170 personnel, with an annual sales rate of 100 scanners of the new-generation 0.23 T ProView open type. The company's R&D and production units are still based in Finland but the company itself is now in the possession of foreign stockholders.

The current owner is Marconi Medical Systems, formerly Picker International. The company had a previous long-standing reputation in medicine, and an efficient sales and maintenance organisation throughout the world.

The Finnish owners had problems in marketing the scanners, due to their lack of an international network and a well-established company image.

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Pyroflow – a multifuel boiler based on circulating fluidised-bed technology

A burning flame

The use of circulating fluidised-bed technology solved many environmental problems caused by the combustion of solid fuels. Among other things, neutralising the sulphur at the combustion stage could check sulphurous emissions.

The circulating fluidised-bed technology uses a medium, such as sand, that is made to float on a strong stream of air. The chemical industry has used this method for several decades. Ahlström Oy decided to investigate the method’s applicability to combustion. The advent of Pyroflow boilers was accelerated by the 1973 energy crises that led to the global adoption of cheap but problematic fuel types.

In 1987, the Award was won by Folke Engström, M.Sc. (Tech.).

The circulating fluidised-bed technology enables the combustion of solid, sulphurous fuels, among others, with the efficient elimination of sulphurous oxides from flue gases. The problem is solved at the combustion stage by feeding lime into the combustion chamber to bind sulphur into gypsum. The solution is considerably cheaper than using separate flue gas neutralisation devices. Due to a low combustion temperature, the nitrogen oxide emission levels are significantly lower than those of oil combustion. Simply spraying ammonia into the combustion process can decrease emissions further.

Pyroflow received the Engineering Award in 1987. At that time, Ahlström’s share of the world’s total circulating fluidised-bed boiler sales was about 40%. Up to that date, Ahlström had supplied these boilers to talling more than 170 million euros.

Global success resulted in a situation where the American Foster Wheeler Group acquired Ahlström’s entire power plant boiler business in 1995. The acquired unit was called Ahlstrom Pyropower at the time. At present, its global market share is more than 50%.

The parent company’s Finnish affiliate is currently called Foster Wheeler Energia Oy with an annual turnover of more than 170 million euros. It is a Finnish, expanding, profitable company employing about 700 personnel in four locations in Finland. Its main markets are found in Central Europe and the Far East. Within the Foster Wheeler Group, the Finnish unit constitutes the centre of excellence for circulating fluidised-bed technology, which means that Pyroflow technology is being developed in Finland on a continual basis.

Moreover, the size of circulating fluidised-bed boilers was successfully increased up to 300 MWe. For example, the TUROW project in Poland has already three 235 MWe units in operation, with another three 260 MWe boiler plants currently under construction.
Developing dissolvable surgical fixation materials for fracture treatment

Screws for bone and marrow

The 1988 Engineering Award was granted to repair plates and screws that dissolve in the human body. Professor Pertti Törmälä, their developer, also received the Nordic Council’s Technology Award the same year.

Damaged body tissues are repaired using implants or foreign components of various types. In cases where a fractured bone is repaired using metal screws, nails and plates, they must be removed through a subsequent operation.

The polymeric repair components developed by Professor Törmälä are equal to steel in strength but once implanted will start dissolving and turn into cell nutrients in time. Depending on the damage in question, dissolving will take from a few months to a few years. Meanwhile, the patient’s own organism will heal the injury, with the fracture being repaired through ossification.

At the time of receiving the Award, Pertti Törmälä and his company Bioscience Oy were pioneers without competitors with similar products in the market. Currently, there are about 10–20 companies producing bio-dissolving implants for the global market. This means that Bioscience is being persistently challenged to defend its patents, currently amounting to about 200.

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Developing electronic measuring instruments and establishing a major business

Inventing the heart rate monitor on a cross-country ski track

A cross-country skiing coach from Kempele met Professor Seppo Säynäjäkangas on a ski track in 1976 and complained to him that manual measurement of the athletes’ heart rate was a slow and inaccurate method. This request from the market led to the development of an electronic heart rate monitor.

Research and product development initially resulted in the Sport Tester heart rate monitor, which provided the key to modern training. The instrument enabled heart rate monitoring during performance with the possibility of analysing the measured results afterwards.

The heart rate monitor could be used to analyse the strain caused by exercise in relation to a target level, and to establish an anaerobic threshold based on the test person’s vital capacity and physical stress (the Conconi Test).

The award winning heart rate monitor consists of a separate chest-borne measurement transmitter and a wristwatch-type receiver that computes and indicates the results. This heart rate monitor was the world’s first wireless solution in the field, and was rapidly adopted by athletes and coaches in the global market. It also became popular among fitness enthusiasts. In addition, a special version has been developed for the training of racehorses. At present, typical users are found among the echelons of amateur marathon runners, for example.

Polar Electro Oy, the company that was established to manufacturing instruments and establishing a major business, has expanded into a group of companies producing a wide selection of instruments and exercise improving computer programs. The latest heart rate monitor models feature several functions, which are derived from the heart rate database and facilitate use, such as automatic personal training level optimisation (OwnZone), heart rate measurement based calorific measurement (OwnCal), and personal fitness level measurement at rest (OwnIndex). To date, a total of over ten million Polar heart rate monitors have been produced.

In 2000, the Group’s annual turnover was about 160 million euros, with the share of exports being about 95%. The Group employs more than 1200 personnel. The company continues to be the global market leader in close cooperation with the world’s leading research institutes.
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Developing a picturephone for digital telephone networks

Picturephone – way ahead of its time?
The 1990 Engineering Award was granted to the world’s first picturephone provided with a colour display. This picturephone was developed for conventional telephone networks and was one of the greatest prospects for Finnish industry at the time. Only one element had not been adequately surveyed: the clientele.

The Finnish picturephone was born in conjunction with a digital image processing research project launched in 1981. The participants had the idea to compress and encode images so as to enable their transmission within the capacity limits of existing telephone lines.

Initially, the development of this idea was half-secret as it was considered to be too utopian and would only consume valuable research resources. Nevertheless, once it had gained momentum, Finnish picturephone technology proved to be at the cutting edge of development on the global scale.

Europe’s first functional picturephone application was the world’s second in 1984, and the world’s first international picturephone connection was opened on a public telephone network from Helsinki to Stockholm in 1987.

The real demand was unknown. The Finnish picturephone was able to exploit the entire existing telephone network capacity and was technologically an extremely successful solution. It was ahead of its time and contemporaries.

The Finnish picturephone was marketed for videoconference and surveillance purposes, among others. The picturephone was not expected to become a miraculous device for every home, at least not immediately.

In addition, companies did not rush to acquire the new device. The project itself was adequately daring and self-confident but no one had investigated whether the callers really wanted their picture taken or to see themselves during a telephone conversation or not.

Nevertheless, these picturephone development efforts did not go to waste and are currently continuing under Nokia Corporation. It seems inevitable that the third-generation mobile phones will be provided with an image transfer function. In the wake of this experience, one thing is absolutely sure: the clients will be asked first and their needs carefully analysed as to what type of image transfer they really want.
Developing tall oil based binding agents

Printing inks from tall oil

Conventional printing used binding agents that were based on oils and resins obtained as by-products from crude oil refineries. Thanks to Juhani Tuovinen’s efforts, these products can now be replaced with tall oil, a by-product from the pulp industry.

The transition is motivated by environmental protection and occupational health and safety issues. Tall oil biodegrades much faster and more efficiently in nature than do mineral oils, and detaches more easily from waste paper. Furthermore, it contains no polyaromatic hydrocarbons, which, when inhaled constitute a cancer risk in printing works and waste paper treatment. Printing inks consist of three basic components: pigment that gives the colour, resin that binds the pigment to paper, and a dissolving agent that turns the mixture liquid but evaporates as soon as possible after printing.

In general, printing works use resins and solvents that are processed crude oil components. They also contain aromatic compounds that have been found to cause cancer in test animals. The dissolving agent can also be based on vegetable oils. Tall oil, which is obtained from the pulp making process, contains both resins and oils that are relatively easy to process further. Tall oil is also cheaper than rapeseed and soya oils, and has an additional advantage of having a steady price level – there are no seasonal fluctuations caused by the success or failure of crops.

Tall oil is preferable for recycling

In the mid-1980s, intensive efforts were launched to develop tall oil based printing inks and major investments were made in the reclaiming of waste paper throughout the world. The efforts focused on developing a product that denkins easily or detaches without difficulty from fibre when used as a raw material in paper production.
Developing a gas-diesel engine

Gas-burning diesel engines
Wärtsilä is a company that succeeded in using natural gas as diesel engine fuel, a couple of years ahead of its global competitors. This research and development work won the Engineering Award in 1992.

Wärtsilä manufactures large-size diesel engines that are suitable for marine and power plant applications. Engines of this type normally run on heavy or light fuel oil.

The use of natural gas offers many advantages, such as low emission levels and a low, sometimes non-existent cost in several applications. The use of gas in the diesel process is plagued with a number of problems, such as its poor ignitability.

In Wärtsilä’s solution, large-size diesel engines were provided with injection equipment that supplies the required amount of gas for each cylinder, plus 5% fuel oil to ignite the mixture.

Marine and land-based applications
Gas-diesel engines are suitable power sources for distributed electricity production in remote housing and industrial areas, and for offshore purposes, oil rigs in particular.

Compared to conventional power plant solutions, diesel engines offer a number of advantages, such as their excellent controllability. Electricity can be produced economically with low emission levels, even on partial loads, contrary to the use of gas turbines, for example.

The disadvantages include poor applicability for large-scale installations, where steam and gas turbines excel. This means that diesel engines have gained a solid foothold especially in medium-sized power plants.

Excellent success
Gas-diesel engines proved to be a success in the market, with the total sales of engines and auxiliaries currently surpassing €73 million euros. Their total joint power is about 900 megawatts – equivalent to that of a large nuclear power plant. Particularly in the mid-1990s, sales gained extra momentum from intensive offshore oil rig construction activities.

Consequently, the trend in oil and gas production has been towards easily transferable units where adaptability to using a wide selection of fuels is a major advantage. The clients know that Wärtsilä’s diesel engines are easily converted to the use of gas, among other fuels. This is a fact that has also assisted the company in marketing its oil diesel engines.
Sensor technological development work

Silicon-based measurement innovation

In the late 1970s, Vaisala anticipated that sensor manufacture would change and move in a similar direction as integrated circuit production. Since the company was in a position to invest in related research, dedicated research efforts were launched.

The work resulted in micro mechanical measuring instruments that were based on controlled etching of silicon discs. Compared to their predecessors, these sensors were small, accurate and cheap. Previously, sensors were manufactured using fine-mechanical methods resulting in sensors containing a large number of precision-made micro components. Following component manufacture and assembly, ready-made products tended to deviate slightly from one another. This means that the instruments in question had to be calibrated so as to have the correct indicator reading scale.

Silicon-etched instruments are produced without assembly, so their properties can remain identical with mass production on a continual basis. Silicon has excellent electrical and mechanical properties that are exploited in manufacture.

The acceleration sensor is a typical new-generation instrument. It contains a miniature silicon rod that is formed into the required shape by moving it from the base plate through etching. As it is attached at one end only, the rod swings when the sensor is subjected to movement. It will bend during acceleration and braking. At the same time, the rod also functions as a miniature capacitor component, which means that its deflection and acceleration can be measured directly as an electrical variable value.

Vaisala transferred its sensor technology to a separate affiliate, due to the fact that these applications were not closely related to Vaisala’s main business activities. VTI Hamlin is currently the world’s leading manufacturer of silicon capacitive acceleration sensors. Most of its production goes to the automotive industry, especially for the triggering systems of safety airbags. With hydraulic suspension becoming standard, these sensors are ideal for suspension system control.
Idegen – computer-controlled brainstorming software

A software package that looks for ideas

Idegen, a computer software application that guides creative problem solving, won the 1994 Engineering Award. In the spring of 1993, it had already gained an award as Europe’s most innovative computer program at the gigantic CeBit Trade Fair in Hanover.

The birth of Idegen was based on Professor Vilkko Virkkala’s ideas and long experience. Among other positions, he had worked as the Kone Group’s Development Director and had seen how important creativity is in the problem solving process.

Idegen software guides the user through various questions that are not directly connected with the problem in question. Instead, the intention is to approach the issue from various angles, to establish whether it can be circumvented in its entirety, for example. The software also suggests that the user tries to dissect the problem and maximise or minimise the related components.

It provides a rational frame of reference for brainstorming and guides the user towards entirely new solutions. A significant feature of the software is that it will not be satisfied with the first idea that comes to mind. Unlike man, it will prolong the brainstorming stage as far as possible. Finally, Idegen will also assist in organising and evaluating the solutions obtained.

Success in Finland

Idegen’s other award-holding developer, Tapani Savolainen, D.Sc. (Tech.), embarked on marketing the Idegen software. Success was excellent in Finland, with more than 7,000 licences sold and over 10% of the country’s executives using the software.

Idegen was successfully sold to foreign markets and was soon distributed to all continents with several language versions made. However, global activities would have required more extensive resources, so Idegen received little attention in global software supply. Nevertheless, corresponding software products have not emerged on the market to date, and a new Idegen version is being developed. Idegen continues to be well-known among those experts who specialise in creativity and its development and steering methods.
Secondary fermentation in the brewery process based on yeast immobilisation technology

Concentrated beer fermentation

The use of immobilised yeast in secondary beer fermentation saves time and space. This method provides breweries with a significant flexibility increment and additional capacity to meet seasonal demand fluctuations. Secondary fermentation of lager-type beer, which is the most popular in Finland, normally takes place in large tanks of some thousands of litres volume. Freely floating yeast cells decompose those substances that cause unpleasant flavours. Typical secondary fermentation takes six weeks, during which time the beer must be kept at a low temperature. The manufacturing stage keeps the fermentation tanks occupied and binds capital resources to half-finished beer.

In addition, the slow production process has adverse effects on business through unexpected demand peaks that are difficult to predict and prepare for; due to heat waves, for example. The 1995 Engineering Award winning Immo method solves these problems. It shortens the secondary fermentation period to a few hours, releasing tank capacity and financial resources for other activities.

Training and permanent jobs

“We trained the yeast cells and created permanent jobs for them”, Esko Pajunen, M.Sc., characterises the Immo method. Consequently, the name comes from immobilised yeast. The innovation is based on a combination of thermal treatments, where unwanted flavour elements are made susceptible to yeast-based decomposition. Following this, the beer is pumped through a layer of yeast contained in a binding agent. The layer’s yeast content is too dense for the unwanted elements to escape decomposition.

The Immo method has been in continuous production since 1995. After further development, it has all the essential prerequisites to conquer the world. “The Immo method is now more attractive than ever before. Equipment suppliers have grasped the chance and are offering special products for the method’s implementation. We have excellent sales prospects”, Esko Pajunen states. East-European countries have expressed a special interest as the potential local clientele appreciates the low investment costs enabled by the method. However, there has been wide interest throughout the world.

The method developers work for the two major brewery groups in Finland, and there are two commercial versions of the method available. Both are protected by a patent and have been introduced to the global market. Further development of the Immo method is geared towards improving the yeast-binding agent. The method is being experimentally applied to the main fermentation process, which can be seen as a major leap forward. Even this is based on two versions, which are both undergoing a pilot phase; in other words tests are in progress on an industrial scale.
Developing a magnetoencephalographic device (MEG) for scanning the entire human head and brain

Producing a magnetic map of brain function

Brain functions generate extremely weak magnetic fields that can only be measured using highly sensitive devices.

Weak signals are extremely exacting to measure, due to the fact that the environmental background noise is thousands of times stronger than the phenomena being measured. On the one hand, the problem has been solved by using isolated screening rooms, and compensation that makes the instrument exclusively sensitive to the fields generated in its immediate vicinity. The only methods that enable fast extra-cranial examination of brain functions are electroencephalography (EEG) and magnetoencephalography (MEG). As a method, MEG is more laborious but has an excellent locating capability, being in the range of a few millimetres.

Regardless of its high technological and protection requirements, the equipment itself is patient-friendly, illustrative and easy to use.

The history of the Finnish MEG scanner starts with high-quality cryogenic research. Measurements are made using superconducting sensors that are frozen in liquid helium to a temperature in the vicinity of –270°C.

To date, the main users of MEG scanners have been drawn from a total of about 100 research institutes in various countries throughout the world. With the advent of clinical applications, the method is currently expanding to patient treatment in hospitals.

The MEG scanner development won the Engineering Award in 1996. At that time, the total scanner sales remained under 10 units. By the beginning of 2010, a total of 27 scanners had been sold. At present, MEG scanner production directly employs 28 personnel in Finland, with at least an equal number employed by equipment subcontractors.

New impetus for product development from business acquisitions

The Finnish MEG scanner manufacturer, Neuromag Oy, was recently acquired by Bayer Technologies Inc., a company that had previously bought its main competitor in the global market. These mergers created a company that is the undisputed market leader with a competitive capability that is greater than the sum total of its parts.

In 1998, the Finnish manufacturer introduced the second MEG scanner generation onto the market. Among other things, it featured enhanced resolution capability, and an increased number of measuring channels – 306, instead of the previous 122.

The history of the Finnish MEG scanner starts with high-quality cryogenic research.
Developing manufacturing technology for thick-walled spherical aluminium tanks

Making large-sized aluminium spheres with high precision

Natural gas is an excellent energy source but transporting it from the other side of the globe requires purpose-built ships. The Turku Shipyard developed an entirely new manufacturing technology for spherical aluminium tanks.

Natural gas is often obtained as a by-product from oil fields. It is frequently supplied through pipelines to consumers but transporting it from the Near East to Japan, for example, requires marine transportation.

The transportable gas, which mainly consists of methane, must be liquified through refrigeration and high-pressure compression. Natural gas is much more difficult to liquify than liquid petroleum gas, its near relative.

Huge dimensions

Each of the four LNG ships that were ordered from Finland in 1993 were provided with four spherical aluminium tanks with a 40-metre diameter. The tank height was equivalent to that of a 14-storey high-rise building, with the required dimensional accuracy remaining in the millimetre range.

The quality requirements were extremely exacting since the high pressure levels call for uniform seam quality. In turn, this requires extreme measurement accuracy. In addition, aluminium is a far more complex material to weld than steel, and the number of aluminium welding experts was relatively low in Finland at that time.

The 1997 Engineering Award was granted as a token of appreciation for the entire technology that enabled the manufacture and assembly of spherical tanks. Once completed, these tanks were assessed as the world’s best, with regard to their dimensional and measurement accuracy.

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Employment for thousands

From the shipyard’s point of view, the LNG ship manufacture amounted to 5,000 man-years. A large number of jobs were also generated in various parts of the subcontracting chain.

The Turku Shipyard has currently no orders for new LNG carriers. But the production facilities and expertise have been retained in expectation of new orders. Spherical tank manufacturing technology is in demand in the global market, and technology transfers are continually in progress within the industry.
Implementing a new radio frequency stage for mobile phones

Small is beautiful in mobile phones

Small dimensions are emphasised in the world of mobile phones. Smallness is a sales advantage in its own right. Compact construction also means lower current consumption, in addition to extended standby and life cycle times.

Compressing the vital mobile phone functions into increasingly smaller compartments provides more space for other functions, such as games, ring tones, and advanced text message features. These all have a direct effect on the phone’s attractiveness.

Mobile phones have extremely high operating frequencies. The signal must be converted into a lower frequency for processing and supplied in the form of speech to the earpiece. Previously, this conversion required a separate superheterodyne stage based on stand-alone components with considerable space and voltage requirements.

Nokia Mobile Phones’ engineering team tackled the problem without prejudice in 1993. Their first achievement was to integrate various functions on a single microcircuit. This resulted in a smaller phone size, lower current consumption and faster assembly.

At the second phase, effort focused on the entire superheterodyne stage, and all the functions were implemented using a single integrated circuit. In spite of initial doubts, the work was successful and the chain of expertise thus obtained has provided Nokia with an extremely valuable competition advantage.

The 1998 Engineering Award was also a token of appreciation for the entire Finnish radio frequency expertise. This area has undergone rapid expansion within a relatively short period of time. At the same time, an entirely new design culture has emerged in our country – one necessitated by short product life span cycles and mass production technology for compact products. Subsequently, this technology has enabled the extremely rapid growth of several technological businesses and subcontractors.

Nokia Mobile Phones had a turnover of over 23 billion euros in 2002. The contribution of this award-winning technology in this result may be difficult to assess precisely but, on whatever scale, it is an amazing achievement.

Their first achievement was to integrate various functions on a single microcircuit. This resulted in a smaller phone size, lower current consumption and faster assembly.
RI-JET Low NOx Pulverised Coal Burner

The burner market niche was found in tangential firing. Coal combustion requires equipment that can minimise the generated nitrogen oxide levels. RI-JET is a burner developed by a Finnish expert team for the purpose of upgrading existing coal-fired power plants to meet the new requirements at a reasonable cost.

In burner design, it is vital to generate such a geometric form that enables the optimal control of the in-flame combustion. The flame's high-temperature portion contains excessive air; this extra oxygen will also burn air-contained nitrogen into nitric oxides. Air must be injected into various parts of the flame, to enable the total combustion of coal with minimal generation of NOx compounds.

The award-winning engineering achievement for 1999 combines Japanese and Finnish combustion and burner expertise. One basic insight originated from a situation where an efficient, reasonably priced Low NOx method did not exist for tangentially fired boilers – one of the two basic pulverised coal burner types.

Another significant feature of the new burner is that it does not increase the boiler plant operation costs. In fact it diminishes them, with the existing burner being replaced by a new, more efficient burner. Furthermore, the modification is mainly restricted to the burner, allowing the use of the existing boiler until the end of its natural life cycle.

In India and China the market is currently opening up. Russia, among others, has a considerable need for upgrades but its current available financial resources are rather insufficient. The RI-JET method is currently being extended to the combustion of brown coal. The world's combustible brown coal deposits are relatively abundant, especially in Eastern Europe. However, controllable combustion of brown coal is a demanding process.

Coal deposits are several hundred million years old whereas brown coal is considerably younger, being in the range of a few tens of millions of years old. Brown coal contains roughly 50% less energy than coal. Brown coal also contains water, ash and sulphur. At present brown coal is burned using outdated, rudimentary burners. These burners are not well-suited for the operation of power plants on partial loads, which frequently means a considerable waste of energy. RI-JET burners also assist in operating the boiler on partial loads.

On a global scale, there is a larger number of tangentially fired pulverised coal boilers with intact nitrogen emission levels. Eastern Europe has already embarked on modification work. Romania, for example, has received four RI-JET burners to date.

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THE FINNISH ENGINEERING AWARD

2000
Tatu Ylönen
SSH Data Security Solution

2001
Jorma Keskinnen, Nikko Moisio, Kimmo Pietarinen, Juha Tikkonen
ELPI - electrical fine particle sizer

2002
Göran Sundholm
Multifunctional water mist

2003
Johani Aittamaa, Juha Jarkula, Guts Krause, Antti Pirilähti, Johani Nikkola
Better petrol by replacing MTBE with iso-Octane

2004
Ari Nikkola, Eero Punkka, Hannu Putkinen
Wristop computer for outdoor enthusiasts

2005
Ile Nickull, Isto Nikkala, Marko Pekkola, Maija Putkinen, Kai Virman
More board from less wood

2006
Aapo Kyrölä, Sampo Karjalainen
New cement without a content producer

2007
Janne Aaltonen, Jukka Henriksson, Pekka Talmola
Achieving a pocket-size TV SET

2008
Matti Harju, Olli Tosavainen, Pekko Tykkyläinen, Janne Sahlstein, Harri Kalliusinen
Removing lactose without affecting flavour

2009
Johani Luostola
World record in diagnosis speed
Correspondingly, entire societies are now at the mercy of the web. An ill-tempered superpower or malicious hackers could bring entire societies to a standstill.

SSH Data Security Solution

The work was launched by a data system break-in detected at the Otaniemi Campus. The event was regarded as a major problem and Tatu Ylönen embarked on finding a solution. These activities initially resulted in an encryption program. The program was easy to use, which was considered a major innovation. In its first year, in 1995, the program had already spread to over 40 countries, and, at present, its second generation is in practical use in all the countries with access to the Internet.

Standstill – the worst nightmare

The Internet has made operations extremely fast and easy, with significant financial savings being made in due course. Consequently, there is no single successful business that can afford to stay outside the web. Correspondingly, entire societies are now at the mercy of the web. An ill-tempered superpower or malicious hackers could bring entire societies to a standstill. This means that the telephone networks, for example, could be jammed along with the Internet. Since the number of production plants, traffic systems and public services operating by remote control is very high, most normal societal functions could stop in this situation.

Global market leader

SSH Communications Security is the global market leader in the field of demanding data network security solutions. Tatu Ylönen previously worked as the company’s managing director but the company’s intensive business expansion compelled it to hire a professional director with broad experience. This enabled Ylönen to concentrate on software development – his real passion. The company has a few hundred potential clients throughout the world; however, they are of a major size with extremely exacting requirements. The size of contracts and orders ranges from a few hundred thousand euros upwards. Due to a relatively low supply and few competitors, the company has a very high development potential.

Pioneer in the global market

As a product, the SSH software has made Finnish programming expertise famous throughout the world. This example has also encouraged other entrepreneurs in the field. Taken as a whole, our national software production has excellent prospects in the near future.

Tatu Ylönen is also an encouraging example of engineering entrepreneurship. His determined efforts to find a niche in the market, followed by persistent product development have led to financial success within a short period of time.
ELPI – electrical fine particle sizer

Detecting fine particles

A team of researchers from Tampere had developed a fine particle analysers that was completed just when the importance and need for this instrument type was realised on the global scale. Its timing was a coincidence – a most lucky one.

The analyser is used to measure air-borne solid particles and aerosols. The measurement range is exceptionally wide, from 10 micrometres to a few nanometres. Another advantage of the instrument is its real-time function with a resolution of about one second. The device is based on an impactor that has been known for a long time. The impactor extracts particles of various sizes from the air stream onto different measurement levels. Previously, measurements had to be made by weighing each division with extreme precision on 60-minute measuring cycles, for example. Now the arrival of particles is registered electronically, and the results can be directly collected on a computer using various spreadsheet programs. Comparing the measuring equipment with previous instruments provides convincing figures. The Tampere method is sever al times better, with regard to its sensitivity, speed, dynamics, and measurable particle size spectrum. In addition, the equipment is easy to transfer and well-suited for field conditions.

Increasing measurement needs

Concurrently with Dekati Oy’s comple tion of its first measuring instruments, the first correlation figures pertaining to unexplained death peaks and air-contained fine particles were verified on the global scale. This observation created a demand for reliable real-time measuring instruments. Research confirmed the fact that microscopic particles, which find their way into peripheral respiratory ducts, constitute a considerable health risk. Which of the numerous fine particle related phenomena constitute a health risk, is not known at present.

This means that there is a continual demand for measuring instruments in laboratories throughout the world. The automotive industry is among the most important clients. Combustion engine emissions have become a major source of fine particle emissions in the world’s cities. The automotive industry wants to react in time so as to avoid the type of problems that the tobacco industry is currently having.

The pharmaceutical industry is another major client that is looking for a reliable insulin inhaler, for example. Compared to the use of injections, inhaling is a much quicker and more pleasant medical treatment method. It also allows one to decrease the required dose.

Parented by the Tampere University of Technology’s Physics Department

Originally, fine particle analyser development was started by the Tampere University of Technology’s Aerosol Physics Laboratory. Once the instrument was ready for commercial exploitation, its development was transferred to Dekati Oy.

In 1997, the company had 7 personnel, with a turnover of 0.6 million euros. Dekati Oy currently employs 26 personnel and its turnover is estimated to be about 2.6 million euros. The share of exports is 85%, down from the previous 95%, as publicity has opened a domestic market. Most of the personnel are currently occupied in research and development activities, which amount to 25% of the company’s annual turnover.

Jorma Keskinen, Mikko Moisio, Kimmo Pietarinen, Juha Tikkanen
Multifunctional water mist

In 2002, the Finnish Engineering Award was granted to Göran Sundholm for his inventions relating to the generation and distribution of high pressure water mist.

In the early 1990s Göran Sundholm had undertaken to deliver a fire suppression system for a ship that was currently under construction. The system was to be lighter in weight than any of its predecessors. Such a system, or its components, did not exist. In addition, time was in short supply.

Nevertheless, a suitable solution was found and the race against time ended successfully. Due to space and weight savings, Marioff’s Hi-Fog system was an instant success, and has now replaced conventional sprinklers.

The advantages of small droplets
Unlike halons, water is a natural fire-fighting agent and causes no environmental problems. In addition, it does not suffocate the people trapped in fire-infested areas.

Water has a high evaporation temperature, which means that it effectively cools down the heart of the fire and any gases emitted from it.

Water mist prevents smoke gases from catching and extending the fire, and binds the soot being generated. At the same time, the heart of the fire is surrounded by a shroud of mist that absorbs the infrared radiation and prevents nearby objects from catching fire in the heat.

The Hi-Fog solution is based on miniature water droplets, which means that the required water volume is only a few percent of that used by an ordinary sprinkler system. Minimising the droplet size dramatically increases their total surface area, which binds the ambient heat to the evaporation process with maximum efficiency. Atomised mist also descends at a much slower rate – another extinguishing advantage.

New solutions for minimising water and smoke-related damage
As the extinguishing process requires a minimal amount of water, water damage can also be kept to a minimum. The cruise ships’ fire protection systems must be light with a minimum amount of water pumped onto the decks. This is due to the fact that water easily shifts the ship’s centre of gravity and creates a capsize risk.

Computer room fires impose a new threat at the fire-fighting front. Even a minor scorching of the cabling may cause the PVC insulation to disintegrate and release acid into the ambient air. This, in turn, will cause irreparable damage to the computers over the next few months.

Göran Sundholm and his Marloff Company have developed a system that neutralises and ventilates the smoke gases from the computer room as soon as the smoke detector smells something burning.

Having gained control of fire fighting on ships and offshore units, Marloff has embarked on developing applications for land-based installations. The approvals from the insurance branch have opened up a retrofit market, in historic buildings, for example. The Hi-Fog system is inconspicuous and easy to install since it requires relatively thin pipes.

Existing installations include underground train stations, with a number of systems also installed on trains.

At the time of receiving the Award, Göran Sundholm had more than one thousand patents and patents pending in his posession. The turnover of all the companies he has established currently exceeded a total of 170 million euros. Göran Sundholm says that he has done most of the thinking work during his business trips, due to the fact that airports and planes rarely offer any other rational things to do.
Better petrol by replacing MTBE with iso-octane

After the Second World War lead tetra-ethyl was widely used for decades as an octane boosting additive in motor petrol. More recently lead became unsuitable due to environmental problems, and as it contaminates catalytic converters. A replacement was found in MTBE (methyl tertiary-butyl ether), which is a chemical from the extremely compression-resistant family of ethers. Vigorous investments in MTBE research in Finland in the 1980’s, made it one of the leading countries in this area, both in terms of know-how and commercial applications. The acquired knowledge proved helpful since MTBE was turning into a mixed blessing.

New food for SUVs

California was the first state to start an intensive debate on the downsides of MTBE. It has a low toxic level, compared to lead compounds, but being water-soluble it easily taints water. Consequently, California has decided to ban the use of MTBE from the beginning of 2004. This prohibition decision has triggered an intensive wave of research projects on the global scale. Regardless of the fact that octane ratings can be boosted by several substances, only a few can adequately meet the current refinery equipment structures and related environmental requirements.

A research team in Finland has succeeded in developing a method for the production of iso-octane. A special characteristic of the solution is that it uses the same raw materials, and largely the same equipment, as the existing MTBE production plants. This means that it is easy to convert production from MTBE to iso-octane. One of the method’s additional benefits is that it does not require a liquid catalytic agent, such as sulphuric acid.

Simulations save time

The team managed to complete their project extremely quickly, within a period of 24 months. Typically, a project of this magnitude, which requires a wide-ranging combination of theoretical and practical research and development work, will take about 5 years to complete. The team’s swift progress was based on extensive utilisation of ICT. This enabled the combining of mathematical modelling and small-scale laboratory tests. Computers were used to simulate reactions and the reaction-required equipment, which minimised the need for large-scale laboratory tests and pilot runs during the research. This, in turn, shorted the construction and test periods. Nevertheless, the team succeeded in identifying the most exacting process components, in addition to those requiring new solutions. The most significant innovative ideas are included in the extraction processes where the required end-product is extracted from the currently non-reactive raw materials. On the whole, the applied chemical reactions are of a type that had never been exploited before on a commercial scale.

A special characteristic of these reactions is their enormous intensity that requires efficient management in two respects. Firstly, swift reactions are more difficult to manage in terms of production conditions. This is directly reflected in production output volumes and product quality. Secondly, and more importantly, this emphasises the role of occupational safety, in other words, the means and methods used by production plants to ensure their employees’ occupational health and safety.

The award winning team members

Compressing a satellite-based positioning system and a computer into a wristop device is an outstanding achievement in its own right. What makes the achievement even more significant is that a wide enough clientele was successfully defined and found for the application in question.

Suunto Oy, a company well-known for its compass products, embarked upon developing consumer devices based on an American satellite navigation system that had been developed for military purposes. The development of a wristop computer including a GPS positioning system was launched in 1999. Yachtsmen were selected as the target group, due to the group’s adequate size and purchasing power. On waterways the availability of accurate positioning data is extremely important since it can be used to include additional features for the device in question thus increasing its added value. Subsequently, device-based applications were developed for golfers and other outdoor enthusiasts. "We had to carefully consider how outdoor sports enthusiasts operate – for example, what a yachtsman or woman does before a yacht race starts. Since there is no time for unnecessary fiddling around in competition situations, the user interface must be straightforward and easy to use, and essentially effective considering the results of the sport in question," says Eero Punkka. In addition to him, Ari Nikkola and Hannu Putkinen participated in the award winning team.

Practical work included several challenging phases, such as designing a receiver antenna that would function properly in all positions, which proved to be an assignment that required in-depth theoretical expertise and numerous tests. The antenna solution and the method used to find and calculate the satellite positions are currently patented. The application uses the earth’s magnetic field and a chronometer for an approximate initial positioning, which enables the device to spot the correct satellites several minutes quicker during start-up.

The customer is king

Regardless of the fact that the world’s smallest GPS positioning device deserves the granted Finnish Engineering Award as an engineering achievement in its own right, the basic device concept is an engineering feat of at least similar magnitude. The Suunto team meticulously considered how to convert its expertise into a product that provides customers with something that they had never thought to ask for in the past.

Since maps cannot be effectively loaded into a wristop computer, altitude and positioning data items must benefit the user in other ways. Golfers are provided with club selection instructions. All the games are stored into a register, with the expanding database improving the player’s performance from game to game. Data can be loaded from the wristop into other computers and vice versa, which means that these facts can be used for preplanning and retrospective analysis.

Suunto’s policy is to produce sports instruments that are the most sought-after in the global market. Results from customer inquiries indicate that the objective is near completion. The device price constitutes a decisive element, which was squeezed down to a reasonable level – being below 700 euros on the Award receiving date. According to Suunto’s own estimate, its R&D team has a 2-year lead compared to its competitors – and you can cover a long distance in that period, in any type of sport.
The 2005 Finnish Engineering Award was granted for the development of a chemi-mechanical pulp manufacturing method. The method reduces raw material and energy consumption and improves the end-product quality. It also allows the plant’s water circulation to be almost completely closed.

The method reduces raw material and energy consumption and improves the end-product quality.

The method reduces raw material and energy consumption and improves the end-product quality.
New content without a content producer

Users interact and process the service content so as to match their personal interests and preferences. Habbo Hotel was established by the Sampo Karjalainen and Aapo Kyrölä among their famous Habbo characters. The 2006 Finnish Engineering Award was granted to an Internet-based virtual community called Habbo Hotel. It is a new, versatile concept among currently available games and entertainment services on the Internet. One of the concept’s special features is that its content is chiefly produced by users, to be shared by other users. Habbo Hotel has quickly become a blockbuster on the global scale, due to its combination of features such as web games and chat room concepts.
Achieving a pocket-size TV SET

Telecommunication engineers compact vision resulted in a pocket-size TV set. Regardless of the fact that the whole project was first condemned in public as impossible, due to the application’s high energy consumption. The 2007 Finnish Engineering Award was granted to a development project launched to develop a mobile TV application. In addition to a digital pocket-size TV set application, the project resulted in a standard that made the impossible possible. Among other countries Finland has adopted the use of a digital TV transmission procedure that is based on transferring several programme channels in the form of a single joint transmission. A receiver set or a decoder is used to disassemble all the channels contained in the transmission code to display the viewer-selected channel on the screen. The system’s energy consumption is relatively low but even this may exceed the battery capacity of pocket-size devices. This is the reason why mobile TV has been generally condemned as impossible. However, the award-winning team had a clear vision of solving the problem in principle, and Nokia had the courage and resources to embark upon developing the vision into a TV application.

A new standard
The fundamental idea in energy saving was to receive and decode only the channel that is being viewed. This meant that transmissions had to be encoded in such a way which enabled the receiving of the data of each channel in the form of chronologically condensed subsequent bursts. The objective was to reduce power consumption to a tenth of its previous level, and this was achieved. In addition programmes are transmitted in a way that prevents viewers from being distracted by damaged bursts since the rectifying data is transmitted within a separate time frame. Fault rectification is a fundamental feature of mobile connections that are prone to disturbances from several sources, including the movements of terminal devices. A small exclusive team was established in 2000 to investigate how the current TV standard should be changed so as to achieve a feasible mobile TV application. There were about 10 companies participating in the project. In addition to a digital pocket-size TV set application, the project resulted in a standard that made the impossible possible. Hundreds of millions of viewers with all its various phases, the development work took almost 10 years to complete with hundreds of engineers participating. It was known right from the project’s initial phase that time would be consumed, among other things, due to the fact that the functional solution would require components that did not exist at that time. The team had confidence in steady technological development, such as the increasing power of micro circuits in accordance with Moore’s law. The assumptions proved to be correct – on the Award granting date ready-made pocket-size TV sets were available in shops and the first transmissions had been launched on various continents. Mass production will continue to lower the device price range, which means an expanding clientele on the global scale – exactly as it happened in the case of mobile phones in the past.
Removing lactose without affecting flavour

New opportunities for Finnish milk

When Finland became an EU member, our agriculture lost its protective tariffs, which was seen as a serious potential threat to Finnish milk producers. However, the tide was turned by means of an engineering work that resulted in the expanding export of a tasty, lactose-free milk drink and won its production process developers the Finnish Engineering Award 2008.

Lactose or milk sugar is a type of sugar that consists of two monosaccharides called galactose and glucose. Following the early infancy period, many people’s digestive systems undergo a change, as a result of which their organisms’ enzymes fail to decompose lactose in the small intestine. This will cause flatulence or, in the worst case, strong diarrhoea – a complaint that is more commonly known by the name lactose intolerance. In low-lactose HYLÄ products, lactose has been broken down into its two monosaccharide components. This sugar modification inevitably changes the flavour as well, and many milk lovers find HYLÄ products too sweet for their liking.

Old process in new bottles

The Finnish dairy company Valio conducted a series of chromatographic whey processing tests in the late 1980s, including the removal of lactose from milk. Thanks to the chromatographic removal of lactose, the product was completely free from sweetness. The sweetness problem was circumvented by using a mixture that contained 50% of a low-lactose HYLÄ product, with the end-flavour quite accurately matching that of unprocessed milk.

In addition to the chromatographic separation technology, lactose has been subsequently removed through ultra-filtration. Both methods have required a great deal of development work. The same applies to intensifying the hydrolysis method so as to be able to decompose the processable lactose in its entirety.

Directive-compliant development

Development work was further complicated by the product regulations as the new product was not allowed to be called milk, once its milk sugar content had been removed. Consequently, the product was launched onto the market as a milk drink, packaged in a familiar milk carton, however.

An additional problem was constituted by the definition of lactose-free-ness, which originated from the margarine industry. The allowable lactose content limit was 0.01 percent, way below the currently achievable detection limit. The problem was solved by developing a new measuring method to reliably verify the content levels.

Success in the market

The new milk drink surpassed all market expectations and found consumers who had entirely stopped drinking milk. Success has been extremely good in the foreign market as well. 2008 sees the method licensed to Spain, Switzerland, South Korea and Mexico.

Prior to Finland’s EU membership, it was predicted that imports from the Baltic countries and Poland would ruin the Finnish milk farms. Currently, however, Finland is an extremely strong milk exporter with a very valuable product. The milk drink price is almost double compared to the basic milk price. This means that our technology development has successfully secured the employment of domestic milk producers.

Removing lactose without affecting flavour

Old process in new bottles

The Finnish dairy company Valio conducted a series of chromatographic whey processing tests in the late 1980s, including the removal of lactose from milk. Thanks to the chromatographic removal of lactose, the product was completely free from sweetness. The sweetness problem was circumvented by using a mixture that contained 50% of a low-lactose HYLÄ product, with the end-flavour quite accurately matching that of unprocessed milk.

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World record in diagnosis speed

The 2009 Finnish Engineering Award was granted to Juhani Luotola, Senior Technology Manager at R&D in Orion Diagnostica Oy, in recognition for his long-term research and development work in nanotechnology. As a concrete result of this work, extremely fast analysis methods are currently available for medical purposes.

One of the most significant applications is the QuikRead system that is used to measure the amount of C-reactive protein (CRP) in the patient’s blood in inflammatory diseases. Test results help physicians to make a diagnosis and assess whether the patient is suffering from a viral or bacterial infection, or to establish whether the administered antibiotic is having the desired effect. The test is the world’s fastest in the field, with the result indicated in one minute.

The Award was justified by the development of a complete test entity, which has required nanoparticle synthesis, the exacting application of surface chemistry, and the development of analysis equipment and mathematical interpretation models. Juhani Luotola started his work in this field of science in 1981.

Displaying the results in the right type of light

In simple terms, the analysis method is based on the progress of light through a sample. An accurate sample is taken with the aid of a capillary. The surface of the nanoparticles contains molecules that react with the C-reactive protein. In cases where a reaction is achieved, the nanoparticles adhere to one another forming larger aggregates. When the sample is subsequently illuminated using a specific wavelength, the measured light is attenuated by an amount that is proportional to the concentration of an analyte in question. A measuring instrument calculates the attenuation and directly displays the result in the form of a numerical value that is easily interpreted by the physician.

The QuikRead CRP test is easy to use and especially suitable for healthcare settings where physicians work close to their patient. It allows immediate testing and provides the test result so quickly that the physician can initiate the appropriate treatment during a single patient visit. Rapid results enhance the overall effectiveness of healthcare delivery by reducing the costs and time associated with handling and sending samples to laboratory, communicating the result and patient revisits. QuikRead CRP can also help to avoid unnecessary antibiotic use and the development of antibiotic resistance.

A complex entity

The currently used particle size is about 100 nanometres, with the deviation being about one nanometre. This is important to observe as the analysis is quantitative by nature. In addition to the particle synthesis, coating the particles with suitable indicator molecules has required a great deal of innovative work and perseverance. The sphere of development has extended to mathematics – to pinpoint the appropriate algorithms for extracting a maximum amount of data from the measurement signals.

On the whole, Orion Diagnostica has been successful in competition. Up until now, the company has been able to avoid product copying by its competitors. The test analysis is an extremely complex entity that requires the type knowhow and expertise which cannot be conjured up from scratch. The results of Mr. Luotola’s development work have been commercialised as part of Orion Diagnostica’s QuikRead system. The company has a turnover of 45 million euros, about half of which is received from the QuikRead system and other products involving particle-based technologies.
2010–

2010 NISTO KUUSJÄRVI, ARI NIEMELÄ, JUHANI SIRÈN
Steady as she goes through stormy waters

2011 HENRY ANDERSSON, PETRI HAAPANEN, PENNTI KARIHUNEN, RENNO KERÄNEN, TIMO LUVI, JUHA SAINIVIARA, RAINER SANMARK
Looking out for a distant drizzle

2012 MIKKO HEMMILÄ, REJO LIHKATAINEN, TOMMI LIHKATAINEN
Steel of superior strength

2013 JANNE KALLIO, HANNU MÄKELÄ, RIUKI PULLI
Machines are taking over in mining

2014 HANNU HUKKANEN, TOMI KUNTTE, PETRI LAUKKANEN, PASI VALLEVUORI, ULLI LAAKKIO
Energy saving light

2015 ESKO TUSA
Use of ion exchangers to absorb radioactive materials

2016 TEEMU HEINO, JANNA RATTLEIN, MATTI KISSI, MARKO KYLÄ-STOPP, MARSI LAARDO, REJO SILTYVAINIO, EERO PEKKALA, JUUGO PELIZHAKA, JONAS REMES, TERÖ TULOKAS
A leap forward in gas burner technology

2017 MARJA AMENA, OLEKU JUSTLA, JUKA LEHTINEN, PIJO SALLINEN, TAINA TÄRÖN
A Gift for the Women of the World

2018 MATTI ISKANUS, TERÖ JÄRVELÄINEN, KIMMO RAUMA, ANTU SARKANEN, RIITTI TAMILYN
Powering up heavy-duty vehicles with electricity

THE FINNISH ENGINEERING AWARD

2010–
Steady as she goes through stormy waters

The 2010 Finnish Engineering Award was granted to the design team of STX Finland Oy’s Turku shipyard with Ari Niemelä, M.Sc. (Tech.), Risto Kuusjärvi, M.Sc. (Tech.) and Juhani Sirén, B.Sc (Eng.) as the team members. The Award was granted for the hull strength and vibration technical design of the cruise vessel MS Oasis of the Seas. Cruise ships of the Oasis-class are the largest in the world and have exceptional construction. Oasis of the Seas is the largest single product ever exported from Finland. Together with her sister ship Allure of the Seas, the construction project required about 12 000 man-years. In order to provide a maximum number of cabins with windows and balconies, the cabins were divided into two towers partly extending beyond the hull. This allowed a spacious “Central Park” to be located in the middle of the vessel. In strength technical terms, the use of two separate towers is extremely challenging, due to the abundance of glass structures and cut-outs required. In addition, the two vessels contain large space activities with long span lengths, which meant that supporting the construction with the aid of bulkheads was not possible.

Vibration hazards
As conventional engine and propeller vibrations have already been eliminated, cruise passengers are increasingly demanding a smoother run. The ships in question are provided with six diesel electric engines with a combined power of 97MW, and are propelled by Azipod units with 60MW input power. The applied engine and propulsion technology is the result of Finnish development work. As the ship’s hull volume increases, its potential natural vibration becomes a problem, due to the fact that large constructions have a low natural frequency. Natural vibration may be induced by waves, for example, generating vibrations with a frequency of about 1Hz, which people experience as extremely unpleasant.

Low-frequency vibrations were calculated in the time-domain and assessed in the form of vibration doses, which were calculated separately for each of the 60 000 measuring points involved. As the strength and vibration properties are inherent features of the hull, the preliminary direct calculations must be carried out in the ship’s concept design phase. Changing the ship concept afterwards is impossible in practice. The calculation basis was created with cruise ship Voyager of the Seas that was handed over ten years ago.

Impressive size
Oasis of the Seas made a world record by being the first cruise ship to accommodate more than six thousand paying passengers. In order to ensure problem-free service provision, all material and occupant flows were modelled in advance thus eliminating any potential bottlenecks. The 2010 Finnish Engineering Award was granted to the design team of STX Finland Oy’s Turku shipyard with Ari Niemelä, M.Sc. (Tech.), Risto Kuusjärvi, M.Sc. (Tech.) and Juhani Sirén, B.Sc (Eng.) as the team members. The Award was granted for the hull strength and vibration technical design of the cruise vessel MS Oasis of the Seas.
Looking out for a distant drizzle

The 2011 Finnish Engineering Award was granted for the ideas and development of a new-generation weather radar.

This weather radar is the world’s first dual polarisation Doppler radar that meets the stringent field and market requirements. It is also a groundbreaking move for Vaisala in a new weather business sector. The corporation already had a worldwide network of marketing channels but achieving the required radar expertise had to start from scratch.

The transmitter of a dual polarisation radar sends both horizontal- ly and vertically polarised microwave pulses simultaneously. When these are reflected from airborne objects, the receiver must be able to interpret the echo accurately. This information is used to establish the precipitation intensity, and whether it consists of rain, snow or hail. The same information can also indicate the direction and intensity of the wind. In addition, it is possible to distinguish interfering signals from the data flow, such as those generated by birds and insect swarms.

The market is building like a hurricane

The demand for accurate weather data has been boosted by developments taken in mobile technology among others. In an exacting construction project, the site manager may use a smartphone to check for the risk of wind gusts before hoisting large components, for example. Once the amount of rainfall can be accurately predicted, the authorities will be in a position to accurately decide the opening and closing schedules for floodgates, for example.

Consequently, the entire field of meteorology is currently focused on producing accurate, regionally specified weather data using various methods, including the distribution of this information in real time. This means that an essential element in weather radar technology is the instant conversion of antenna-supplied signals into a clear and easily understandable forecast.

Extensive cooperation

The award-winning team is the largest in the history of the Finnish Engineering Award. This also proves the multi-disciplinary nature of the technological expertise required by this new radar type. As such, benefits of a dual polarisation radar have been known for a long time, and a few pilot systems were previously built in various parts of the world. Nevertheless, a device that could meet the requirements of continuous use was still missing.

In view of the final result, signal processing and software development were also of major significance. Conventional engineering work, i.e. mechanical expertise, was required for the design of the antenna and its movements.

The first dual polarisation weather radar set was manufactured in 2007, and by the award-winning date, radar deliveries had been made to 13 countries. In addition to new investments, there is a strong, continual radar demand in the weather business, due to the current renovation and upgrading trend in the global market. The price of a single radar set is about one million euros.
Steel of superior strength

The 2012 Finnish Engineering Award was granted to an R&D project team whose efforts resulted in the development of a new ultra-high-strength steel grade. The team worked at the Rautaruukki steel mill in Raahene, Finland, and consisted of Mikko Hemmilä, M.Sc. (Tech.), Reijo Liimatainen, Foundry Technician, and Tommi Liimatainen, M.Sc. (Tech.). Reijo Liimatainen is the creator of the Award-winning idea and Tommi Liimatainen is his son.

The central idea of this work is the direct quenching of hot-rolled steel where a tempered steel strip is produced during a single process phase. This means that a hot strip is processed controllably at high temperatures typically above 900 °C. Following this, the strip is immediately tempered by cooling it quickly with water to room temperature. The common conventional practice is hot-rolling the steel plates in a separate process phase and letting them cool freely, after which the steel is reheated and cooled quickly. The benefit of direct quenching is that the process saves time and energy, and, surprisingly, results in a product with superior properties.

Lucky accidents

It was in the early 1980s that foundry technician Reijo Liimatainen made the observation that the reject- ed steel that remained on the production line after a production shut-down, appeared to be of an exceptional strength and ductility, and proved extremely challenging to remove. The idea matured slowly through a number of phases but the first production tests were not launched until the beginning of the 2000s. The idea of direct quenching had been tested previously, in Japan, for example, but only with thick steel products at a plate mill.

The steel production test batch was an immediate success. The method was patented in a way that protects all alloys and methods applicable to high-strength steel. Since production started, the production volumes have exceeded the original estimates by more than a hundred fold, and sales have expanded into China and countries in the southern hemisphere, among others.

To date, competitors have made no effort to copy the method because it would be technically challenging.

Mikko Hemmilä, Reijo Liimatainen, Tommi Liimatainen

An extremely exacting process

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In addition, the patent protects producible alloys in a way that causes the risk of cold brittleness to producers aiming to circumvent the protection.
The 2013 Finnish Engineering Award was granted to AutoMine, a long-term development programme of Sandvik Mining that is currently revolutionising the mining industry. The award winning team consisted of Janne Kallio (B.Sc.Eng.), Riku Pulli (M.Sc.Eng.) and Hannu Mäkelä (D.Sc. Tech.) who collaborated with Sandvik’s AutoMine team to develop a new automatic control system for mining machines and their navigation. Thanks to the new system, the remote control of a mine’s loaders and trucks can be restricted to the most critical phases of work. At other times, these vehicles move independently along the narrow galleries – at their maximum speed when necessary.

Automation enables a single person to control several machines at the same time. The operator uses remote control to fill the loader bucket and automatically sends the machine to a discharge point where it tips the bucket and then returns fully independently.

An additional unique feature is that the system provides a total overall picture of the mine and its machine operations. It is now possible to view and manage the imperceptibly complex combination of labyrinthine excavations and mechanical equipment in the form of a process. This boosts productivity and safety to an essential degree and provides additional information, for maintenance purposes among others.

Finnish interdisciplinary expertise
Several teams have been involved in this work, the roots of which date back to the mid-1990s. By the 1990s, Finnish ICT expertise had reached a truly high standard. At the same time, the nation’s know-how of mobile machine construction was also of the highest global standard, and the combination of the two competences provided the opportunity to accomplish a mining automation solution of this type.

There has been a clear need for automated mining, due to the fact that ore deposits are currently found in areas of increasingly difficult access. Travel to work at a distant mine production area that is possibly located at a high elevation may take several hours, which means that placing the control room tens of kilometres closer to urban areas is an economically viable option. Automation enables machine operation during the change of work shifts, and in situations where the galleries are still filled with blasting fumes, for example.

Among other things, this development work was spurred on by the tightening of safety regulations, first in Australia and then on the global scale. The elimination of the human work force from the production areas, ore extraction and transportation improves safety and enables its integration with the rest of automation.

Navigating with the aid of laser scanners
The basic solution is an environmental model of the mine created with the aid of laser scanners. The model and the scanners enable machine navigation without the use of positional aids installed on the gallery walls. Competitors have been using their own navigation technologies, such as navigation systems based on automatic cable control, tape lighting or reflectors. However, those methods have their limitations, for example component failures, maintenance requirements and the anticipation of curves during driving. This is why the machines using the said technologies must be driven at lower speeds when in operation. Automation is not profitable if it cannot beat the speed of manual drivers.

Global standard
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Energy saving light

The 2014 Finnish Engineering Award was granted to LEDiL Oy, a company based in Salo, for development work extending throughout the company history. The award-winning innovation consists of LED lighting optics development so as to achieve an optimum level of luminous and visual efficiency. The company was established at the beginning of this millennium to exploit the currently new white high-power LEDs. The emission of light in a wide angular spread is a typical feature of these LEDs, which meant LEDiL decided that people have been accustomed to wasting light throughout the history of lighting, and mostly, problems have been solved by increasing the wattage. From early on, LEDiL has endeavoured to achieve the best luminous efficiency possible, so as to provide ideal distribution of photons onto the target surface. This is an extremely significant advantage, especially in conditions where electric power is in short supply, on the one hand, and in major lighting installations, such as the street lighting of entire cities, on the other.

Trailblazing on the global scale

Having participated in the initial development of power-LED-based lighting solutions, LEDiL has also contributed to the field’s standardisation. One of the areas involved is the standardisation of LED-light interfacing technology in cooperation with the world’s leading connector manufacturers. The Award-winning team has also participated in introducing new materials and work methods to Finland. An example of these is optical silicone, which has outstanding properties as a lens material compared to conventional acrylic plastic. The world’s first silicone-based standard lenses were manufactured by LEDiL’s subcontractor Masamuovi Oy in Salo, Finland. Another subcontractor of LEDiL’s, the Some- ro-based Laukamo Ltd, uses the very latest vacuum metalizing process in the manufacture of standard reflectors, which is also a new method in Finland. Almost half of the company’s personnel are engaged in product development duties, with their labour cost covering about 6.3 percent of the company’s turnover. The product selection is developed on a continual basis, with the development initiatives mostly coming from the clients. During the past five years, the company’s turnover in Salo has increased from 10 to 60, and the turnover has risen at a corresponding rate to about 18 million euros in 2013. The sales are expected to increase by about 40 percent by the end of 2014. The secret behind the company’s success was to immediately seize and adopt the new technology and incessantly pursue related development efforts.

Promising prospects

LEDiL is a recognised market leader in the LED optical field, in terms of technology and sales figures alike, with the world’s largest product pate. Its clientele includes world famous lighting device manufacturers such as Osram, Philips and Trilux. The company’s global distribution network covers all major markets, with the exported products sharing about 99 percent of its annual sales. Lenses cover 85 percent and reflectors 15 percent of the company’s production and product design focuses on modularity, ease of installation, luminous efficiency as well as visual quality. The product selection is developed on a continual basis, with the development initiatives mostly coming from the clients. During the past five years, the company’s turnover in Salo has increased from 10 to 60, and the turnover has risen at a corresponding rate to about 18 million euros in 2013. The sales are expected to increase by about 40 percent by the end of 2014. The secret behind the company’s success was to immediately seize and adopt the new technology and incessantly pursue related development efforts.
Use of ion exchangers to absorb radioactive materials

The 2015 Finnish Engineering Award was granted to Fortum and Esko Tusa (M.Sc.Eng.) for the NURES® Nuclide Removal Solutions technology that is based on the use of highly selective ion exchangers. These ion exchangers have a phenomenal efficiency in the removal of radioactive elements.

The development of NURES® and the required ion exchangers was launched at the Loviisa nuclear power plant to remove caesium - an element with a half-life of about 30 years - from the plant’s waters. The next step was to develop a suitable material for strontium that also has a half-life of about 30 years, and then for cobalt and other corrosion products.

Caesium is an alkali metal and strontium an alkaline earth metal, which means that a specific ion exchanger is required to prevent other related elements from disturbing the reaction. Especially in the case of caesium, competing elements are also highly soluble, which means that the use of a highly selective ion exchanger is virtually the only reasonable method under certain circumstances to remove these elements from water.

The development work started in the early 1980s and the first ion exchanger applicable to the method was completed in 1985. Success required selective ion exchange and refining the material’s mechanical structure in order to achieve a compound which can withstand the flow-induced forces. In addition, the structure had to be of a type that enables the fast and steady flow of water through the inorganic exchange material.

The system was given the name NURES (Nuclide Removal System) and was commissioned at the Loviisa nuclear power plant in 1991. Up until now, the power plant has saved about 55 million euros compared to treating the waters with other available methods, chiefly involving the production of concrete. NURES was converted into a commercial product and about 50 solutions have been delivered to date throughout the world, plus about a dozen minor applications delivered chiefly for research purposes.

Publicity through Fukushima Previously, only a selected few people were familiar with NURES but the waters flooding the Fukushima nuclear power plant caused a disaster that was impossible to manage rationally by any other method.

Fortum’s highly selective ion exchangers were so effective in the treatment of saline water that the measurability of removable materials after the treatment was practically non-existent. As Mr. Tusa consequently states, the more difficult the situation, the more unbeatable NURES is.

Even if the synthetic ion exchange material is rather expensive, the method’s efficiency, low operating costs and its insignificant material volume requirement makes it quite affordable to end customers. Compared to the zeolite method, for example, the difference is one to two thousand times better. Furthermore, NURES is capable of a purification efficiency that removes caesium and strontium from the waters beyond the level of measurability.

Significant markets may be opening up for the method in future, due to the fact that there will be more than 200 nuclear reactors all over the world awaiting to be decommissioned within the next two decades, each containing thousands of cubic metres of treatable water.

Esko Tusa says that the method has worked flawlessly in every installation where it has been applied. It has also been successfully used in a sodium-potassium cooled reactor operating in northern Scotland, regardless of the considerable mistrust demonstrated in advance regarding the method’s functionality. In addition, ion exchange materials have been developed for Fortum’s method for the removal of antimony and technetium. A method for the removal of nickel is also being developed, and the overall aim is to remove all reactor-induced cumbersome elements. The material developed for the exchange of strontium also removes arsenic which constitutes a problem in a number of conventional chemical processes.
A leap forward in gas burner technology

The 2016 Finnish Engineering Award was granted to a team of ten engineers, for a gas burner they had developed for the Oilon Group Oy, a company based in Lahti, Finland. The new burner enables the reduction of nitrogen oxides contained in flue gases down to a level that was previously regarded as extremely difficult to achieve. At the same time, it also became possible to increase the combustion efficiency, even if the two objectives were conventionally seen as mutually conflicting.

Oilon had been supplying burners to power plants for a long time, and had managed to cut down the amount of flue gas contained nitrogen oxides (NOx) from 150mg to 100mg, within a single decade. However, Beijing made a political decision in 2013, requiring that the NOx emissions of all new gas burners must be reduced below the level of 30mg, within a period of three years.

On the global scale, several burner solutions had been developed that enabled the fulfilment of this requirement. These were based on flue gas recirculation and the injection of ammonium compounds into flue gases. Nevertheless, these methods reduced the combustion efficiency and increased the operating costs to a considerable degree.

The requirement set by the Chinese in 2013 appeared to be extremely hard to achieve but the team was enthusiastic and embarked upon solving the problem by means of catalytic purification. The solution required conventional engineering work and a cross-disciplinary approach since the flow technology, combustion chemistry, materials, catalysis and automation, in particular, had to be of a type that allows rapid and accurate control of the combustion process and subsequent events.

Downstream from the burner, the flue gases pass into a catalytic converter, the size of which is several cubic metres, where the harmful compounds inter-react in an oxidation-reduction process. The process decomposes the nitrogen oxides and increases the flue gas temperature. This means that the initial unaltered volume of natural gas can generate the maximum amount of energy for the boiler.

A huge market

Thanks to the pure and efficient combustion process, the same amount of gas produces more energy without the use of ammonia or any other auxiliary chemicals like urea. These are the facts behind the burner’s affordable operating costs that make it possible to pay back the higher investment costs within a reasonable period.

By and large, the investment made in product development has already been covered and several major markets are just opening up. The State of California already requires the NOx level of 30mg, but the local burners use a different technology resulting in lower combustion efficiency, more complex systems and higher investment costs. Consequently, it is likely that power plant modernisation projects will be forthcoming, on the one hand, and that even private companies may switch to low-emission burners for image-related reasons, on the other.

West-European cities commonly maintain an emission volume limit of 100mg, but this limit may be lowered within the next few years. In that situation, the power plants would be compelled to use the best available technology (BAT), which would open up a huge market within the EU as well.

A leap forward in gas burner technology

The 2016 Finnish Engineering Award was granted to a team of ten engineers, for a gas burner they had developed for the Oilon Group Oy, a company based in Lahti, Finland. The new burner enables the reduction of nitrogen oxides contained in flue gases down to a level that was previously regarded as extremely difficult to achieve. At the same time, it also became possible to increase the combustion efficiency, even if the two objectives were conventionally seen as mutually conflicting.

Oilon had been supplying burners to power plants for a long time, and had managed to cut down the amount of flue gas contained nitrogen oxides (NOx) from 150mg to 100mg, within a single decade. However, Beijing made a political decision in 2013, requiring that the NOx emissions of all new gas burners must be reduced below the level of 30mg, within a period of three years.

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The company owners, among others, believed in the success of the project and had the courage to make a considerable investment in the design work and the pilot equipment.
A Gift for the Women of the World

A hormonal intrauterine system is one of the most effective contraceptive methods to promote the independence and improve the daily life of millions of women. The system's development started in Turku, Finland, more than 40 years ago resulting in the Finnish medical industry's most successful single export product in 2001, with its subsequent annual sales continually exceeding the limit of one billion euros.

The principle of a contraceptive coil has been known in some cultures for a fairly long period of time. A foreign object embedded in the womb of a woman reduces her chances of getting pregnant. In hormonal contraceptive coils, this mechanical contraceptive effect is combined with a hormonal one that is familiar from the use of contraceptive capsules. However, a coil's hormonal effect is mainly local, and the hormonal content levels detected in the circulation are lower, compared to those of pills, for example.

The Finnish Engineering Award 2017 was won by the globally successful product family built around the hormonal intrauterine system (IUS). The development time span of this product family has been exceptionally long requiring a systematic cross-disciplinary approach. An additional feature is the extent of the medical research, tests and approval processes – due to the differences between official requirements in various countries that have multiplied the need for extra work.

Product development work involves several sectors of material technology. A contraceptive coil consists of a frame that remains in the uterus, a hormone-dosing core section with a surface diaphragm connected to the frame, and an extraction string for the removal of the coil. In addition, an applicator is required for the insertion of the coil, and all the materials used must be compatible with one another and with the human organism. The development and selection of these polymeric materials are an essential element in the award-winning product.

From laboratory research into mass production

Initially, the manufacture of contraceptive coils almost exclusively consisted of manual work. However, due to the increasing demand in the global market, automating the manufacturing process became a must. In view of the requirements for safety and accuracy, the task at hand was challenging but feasible. Achieving a billion-euro turnover would not have been possible without the use of controlled production automation, and scaling up the production process was an essential component in the engineering award.

Conquering the world is also connected to the fact that Leiras, initially a national company, has ended up as a member of the global Bayer Group through business acquisitions. The product represents Finnish leading-edge expertise and has been able to advance through the massive marketing channels provided by the global conglomerate.

Up until now, only one serious international competitor has emerged for the hormonal intrauterine system, which proves that the product entity is difficult to copy. Finnish multidisciplinary expertise is also emphasised by the fact that Bayer has not relocated the research or production department to Germany, for example.
Powering up heavy-duty vehicles with electricity

Fully electric and hybrid solutions provide excellent results when applied in heavy-duty vehicles. At best, fuel consumption is reduced by half, but the greatest benefit is obtained from improved productivity, however. The award-winning team developed a smart transmission system that can be applied to a variety of heavy-duty vehicles and ferries.

Visedo Oy, a Lappeenranta-based company, has designed an electronic transmission solution to operate in the demanding work machine environment. The system’s central components consist of power electronics and a permanent magnet motor that are controlled by computer software.

The motor and the electronics are liquid-cooled, with a space requirement that is low enough for installation in a forest harvester, for example. The control system supervises that the electric motor also works as a generator, which means that electrification cuts the diesel engine’s power peaks and, correspondingly, generates electric power when the combustion engine is running idle. Consequently, the diesel engine’s running speed will mostly remain in the rpm slot reserved for optimum efficiency.

There is a wide range of applications for the power electronic components that have been developed. This means, among other things, that a single device can be used either as a frequency converter for motor control, or as a voltage converter that charges and discharges a supercapacitor. The award-winning technology is used to supply electric power to wheeled loaders, lorries, rock crushing machinery, ferries and ships. The company’s key customers include Volvo CE, Logset and Sisu Auto.

Productivity is the greatest benefit

For a long time, Visedo used to promote the enhanced fuel savings as its main argument in marketing, which was really significant: at best, fuel consumption was reduced by 50 percent. Nevertheless, the increase in power and productivity, which could be as high as 40 percent, was more significant in the end customers’ view.

The new technology was originally developed for hybrid machines but has been successfully adapted to fully electric solutions as well. In mines, for example, machine exhaust gases constitute a major problem, which means that the electrification of rock crushers and transportation vehicles provides several benefits at the same time. With regards to rock crushers, productivity increased by 68 percent, and the machine payback time is now only nine months.

Visedo’s technology is currently being applied to implementing the world’s largest fully electric car ferry in Denmark, where the batteries’ total capacity is 3.4 megawatt hours. The size of the frequency converter is 70 percent smaller compared to conventional frequency converters, so the saved space could be used for payload purposes.

Significant environmental effects

The general public is chiefly interested in electric cars, but the possibility to reduce environmental emissions is much higher with heavy-duty vehicles and work machines. These are provided with much larger engines that are up and running almost continuously. This is why the environmental effects of Visedo’s technology are more significant than those of all the world’s cars put together.

The award-winning technology is based on Finnish frequency converter expertise – and, indeed, the first Finnish Engineering Award was granted to the trailblazer in this field. It appears likely that Finland is going to hold its position as a superpower in power electronics.

Furthermore, the Finnish Engineering Award has always meant that the award-winning engineering work has proven to be a financial success. In 2017, Visedo’s turnover increased by almost 80 percent, and the company was acquired by the large industrial group Danfoss in the autumn of 2017. Industrial activities and development work will continue in Lappeenranta, having now a much wider basis to its financing and marketing channels.
Rules and Criteria

The Finnish Engineering Award shall be granted by the Finnish Association of Graduate Engineers TEK and Tekniska Föreningen i Finland TFiF as an acknowledgement of notable engineering or architectural innovation. The purpose of the award shall be to emphasise the importance of engineering and architectural work in our society.

1. The Finnish Engineering Award shall be granted annually to a person or team that has made a significant contribution to Finnish technological expertise. The award-winning engineering work may be characterised by an element of creativity, originality, or by practical implementation of the idea or theory in question.

2. When evaluating the awardees, their works’ commercial and economic aspects shall also be considered. When assessing persons in executive positions, or employed in administration or marketing, special attention shall be paid to their achievements in the field of engineering.

3. As far as possible, the awardees shall be drawn from different fields in different years. An award-winning engineering achievement may have been completed prior to the granting of a previous Award.

4. The Finnish Engineering Award shall consist of a Certificate of Honour and a Pecuniary Reward, the amount of which shall be separately decided by TEK and TFiF.

Approved by the meeting of STS on 14th May, 1981
(TEK from 1993)
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The prize is awarded annually by The Finnish Association of Graduate Engineers TEK and Tekniska Föreningen i Finland TFiF. In 2018 the monetary award amounted to 30 000 euros.