Millennium Technology Prize 2018

Terms of Reference for the Selection Committee

1. Millennium Technology Prize

The Millennium Technology Prize is Finland's tribute to innovations for a better life.

The prize promotes technological research providing solutions to global challenges, and Finland as a high-tech country.

The rationale behind the international Millennium Technology Prize is the extensive impact of science and innovation on society, and humanity at large.

The general principles of the Millennium Technology Prize are as follows:

- Awarded to **groundbreaking technological innovations that enhance the quality of people's lives** in a sustainable manner.
- The innovations have been **applied in practice** and are delivering extensive change now and in the future.
- The innovations **stimulate further cutting edge research and development** in science and technology.

As the Millennium Technology Prize is designed to encourage further cutting-edge research and development, it is not intended as a reward for a lifetime achievement. The Millennium Technology Prize tries to bring the benefits of the Finnish practical and solution-focused mindset – one of the greatest strengths of Finland – to the whole world.

Candidates are sought from across the world and all fields of technology (excl. military technology). In a global world, people's lives are affected by common problems and solutions. It is therefore also essential that a Finnish prize can be awarded to innovations created anywhere in the world.

The Millennium Technology Prize is awarded and managed by Technology Academy Finland (TAF). The Prize is worth 1 million euros, granted by the Ministry of Economic Affairs and Employment from the State budget.

Nominations for the Prize can be made by academies, universities, research institutes, industrial organizations and companies, not by individuals.

The Prize is awarded every second year, and the next time it is awarded in May 2018.

2. Nominations

The next nomination period begins in March 2017 and closes at the end of July 2017. Nominations from all fields of technology and across the world can be made by science academies, technology academies, universities, research institutes, companies and industrial organizations. Candidates

can be either individuals or research groups, who have contributed to a discovery of the innovation. Nominations by individuals, as well as self-nominations are not accepted.

The nominations are to be delivered electronically through the nomination website (www.millenniumprize.fi/cfn) which also includes all necessary instructions.

3. The actors and decision makers

The Pre-Selection Committee members are mainly Finnish experts. It constructs a short list of potential candidates and presents this to the Selection Committee. The Pre-Selection Committee is nominated by the Board of Technology Academy Finland.

The Selection Committee (SC) members include eight eminent scientists from academia and industry, representing a wide range of technology related disciplines. The SC members are appointed by the Board of Technology Academy Finland in October, 2016. Technology Academy Finland has granted Aalto University the right to nominate members for the SC.

External experts evaluate individual nominations against the Criteria of Evaluation. They are appointed by individual members of the SC or the Pre-Selection Committee, based on their expertise in the field of a particular nomination.

The Board of Technology Academy Finland consists of 16 members who represent technology academies, universities, industry and public administration. The Board members are appointed by the previous Board for a term of three years. The term of the current Board runs until April 2018.

4. Pre-Selection process and Pre-Selection Committee

The Pre-Selection Committee evaluates nominations against the Criteria of Evaluation, constructs a short list of potential candidates to receive the prize and presents the short list to the Selection Committee. The short list is forwarded to the Selection Committee by the end of October, 2017. The short list serves only as a guideline to the Selection Committee. The Selection Committee works independently and has a full right to select the winner also from outside the short list.

The Pre-Selection Committee is nominated by the Board of Technology Academy Finland based on a proposal from the Executive Committee of Technology Academy Finland. The Pre-Selection Committee members are mainly Finnish experts and represent a wide range of technology related disciplines. Their individual research areas include life sciences; material technologies; information and communications technology and digitalization; energy, environment.

The President and CEO of Technology Academy Finland acts as Chairman of the Pre-Selection Committee.

5. Selection process and the Selection Committee

The Selection Committee (SC) members include eight eminent scientists from academia and industry, representing a wide range of technology related disciplines. The Chairman of the Committee has to be a Finn. In addition to broad scientific knowledge, they are selected for their individual special research areas which include: life sciences; material technologies; information and communications technology and digitalization; energy, environment and water.

The SC members are appointed by the Board of Technology Academy Finland in October, 2016. Technology Academy Finland has granted Aalto University the right to nominate members for the SC. After each selection round, at least two members of the Committee are replaced. The term of each Committee member is eight years at maximum i.e. four rounds.

The President and CEO of Technology Academy Finland acts as secretary of the Selection Committee.

The task of sifting and assessing the Millennium Technology Prize nominations falls to the SC. The work of the SC includes two physical meetings in Helsinki: the first in November 2017 and the second in February 2018.

Individual members of the Pre-Selection Committee or the SC may appoint External Experts to evaluate individual nominations against the Criteria of Evaluation. The External Experts are chosen based on their expertise in the field of a particular nomination. Typically two or three External Experts are used to evaluate each nomination. The names of the External Experts shall remain confidential and known only to the nominating Committee member as well as the President and CEO of Technology Academy Finland.

The SC makes a proposal for the Prize Winner (or team of Winners) to the Board of Technology Academy Finland by February 15, 2018. The proposal is to include the motivation for the choice and a statement describing whether the Committee's decision was unanimous.

Should the Committee not reach a unanimous decision, then the names of all candidates proposed by individual members of the Committee must be forwarded to the Board of Technology Academy Finland for the decision of the Prize Winner.

6. The Criteria for Evaluation

6.1 Present impact of innovation on quality of life and sustainable development

Facts, estimates or perceptions on

- public awareness and appreciation, visibility in media
- size of concerned interest groups
- degree of deployment within interest groups
- industrial exploitation in terms of
    - new products, processes and services
    - market share, value and sales volume
    - new business ventures and start-up companies
    - jobs created
- impetus on scientific community and its R&D preferences and direction
- role of innovator(s) in implementation of innovation and related R&D activities

6.2 Degree of change in underlying technology

- fundamental, ground-breaking
- radical, disruptive
- incremental, extrapolative

6.3 Potential impact of innovation on quality of life and sustainable development

Estimates and perceptions of future impact (cf. criteria above).

6.4 Identifiability of innovation and innovator(s)

- definability of innovation
- uniqueness of innovation
- identifiability of innovator(s), patent rights
- unambiguity and robustness of nomination material

7. Confidentiality and compensation

Members of the Pre-Selection Committee and the SC shall have access to all material prepared by the nominators. Both the Pre-Selection Committee and the SC may use External Experts to evaluate individual nominations against the Criteria of Evaluation. An External Expert shall have access only to material of that nomination (those nominations) that he/she is assigned to evaluate.

Members of the Pre-Selection Committee and the SC, as well as the External Experts shall sign a non-disclose agreement with Technology Academy Finland. The name of the winner is to be kept secret until the official ratification and announcement by the Board of Technology Academy Finland. Any other material related to the nominations, evaluation as well as pre-selection and selection process is to be kept secret indefinitely.

Members of the Pre-Selection Committee, the SC and the External Experts are expected to work *pro bono.* Technology Academy Finland shall compensate reasonable travel and accommodation expenses related to the evaluation and the selection duties.

8. The announcement of the Winner and the public lecture by the Winner

The Millennium Technology Prize Winner (or team of Winners) is selected by the Board of Technology Academy Finland, based on the recommendation of the SC. The Winner of the 2018 Prize is announced at the award ceremony in May, 2018. The SC and Pre-Selection Committee members are invited to the award ceremony, the patron of which is the President of the Republic of Finland.

The Winner is expected to be physically present at the award ceremony in Finland and give a public lecture on the day following the ceremony.

9. The Winner

The Millennium Technology Prize Winner (or team of Winners) is selected by the Board of Technology Academy Finland, based on the recommendation of the SC. The Winner of the 2018 Prize is announced at the award ceremony in May, 2018. The SC and Pre-Selection Committee members are invited to the award ceremony, the patron of which is the President of the Republic of Finland.

The winner is expected to sign a Memorandum of Understanding with TAF including the following:

- The Winner makes a commitment to be physically present at the award ceremony in Finland and give a public lecture on the day following the ceremony.
- The winner makes a commitment to be physically present and give a presentation at two (or three?) other TAF events during a period of two years following the award ceremony

10.Previous winners

FRANCES ARNOLD, 2016
Pioneering directed evolution: Directed evolution mimics natural evolution to create new and better proteins in the laboratory. This technology uses the power of biology and evolution to solve many important problems, often replacing less efficient and sometimes harmful technologies. Thanks to directed evolution, sustainable development and clean technology become available in many areas of industry that no longer have to rely on non-renewable raw materials.

STUART PARKIN, 2014
Increased data storage density: Spintronic devices, which rely on the magnetic spin angular momentum of electrons, have enabled a thousand-fold increase in the storage capacity of magnetic disk drives. This has led to an explosion of storage capacity, underpinning the evolution of large data centers and cloud services, social networks, music and film distribution online.

SHINYA YAMANAKA, 2012
Ethical stem cell research: Stem cells can hold the key to effective new treatments for illnesses and building spare parts for our bodies. Mature human cells can be reprogrammed to revert into a more basic form and stem cells. Thus, stem cells can be produced without using human embryos. Scientists all over the world are pushing forward stem cell research with the promise of huge advances in the treatment of illnesses like cancer and motor neuron disease as well as personalized regenerative medicine.

LINUS TORVALDS, 2012
Linux kernel open source operating system: Open source operating systems are the basis of many smartphones, tablets, digital television recorders and supercomputers all over the world. Today millions of people are using devices with Linux at their core that make their work and social lives much easier and more pleasurable. The open source movement sparked by the Linux operating system evolved as a collaborative effort making it available for the general public free of charge.

MICHAEL GRÄTZEL, 2010
Dye-sensitized solar cells: The dye-sensitized solar cell is often described as 'artificial photosynthesis' and is a promising long term alternative to standard silicon photovoltaics. It is made of low-cost materials and does not need an elaborate apparatus to manufacture.

ROBERT LANGER, 2008
Controlled drug release: The development of increasingly sophisticated drug release systems promises improvements in the way we treat illnesses. These systems can control the delivery of carefully measured doses of medicine precisely where and when needed.

SHUJI NAKAMURA, 2006
Blue and white LEDs: LEDs are highly energy efficient, emit little heat, and last for a very long time. Today LEDs are mainstream technology in several fields: high-brightness blue and white LEDs are used in lighting, computer displays and new generation DVDs.

TIM BERNERS-LEE, 2004
World Wide Web: The World Wide Web is now an irreplaceable tool for all Internet users. It has revolutionized the way in which we interact with each other, acquire information and communicate. Thanks to HTTP protocol, HTML language and URLs, web users can access information in a variety of formats using just a web browser.

Several Millennium Technology Prize winners have later been awarded by other prestigious prizes such as the Nobel Prize (Shuji Nakamura in 2014 and Shinya Yamanaka in 2013), and by the Queen Elizabeth Prize for Engineering (Tim Berners-Lee in 2013 and Robert Langer in 2015).

11. Process overview for Millennium Technology Prize 2018

October 2016	Nomination of the Selection Committee by the Board of Technology Academy Finland
April 2017	Nomination of the Pre-Selection Committee by the Board of Technology Academy Finland
March – July 2017	Nomination period for the 2018 Millennium Technology Prize
August – October 2017	Pre-Selection process
October 2017 – February 2018	Selection Process
April 2018	Selection of the Winner by the Board of Technology Academy Finland
May 2018	Announcement of the Winner, the award ceremony and the public lecture by the Winner
Fall 2018-Spring 2020	Participation of the Winner in a workshop on innovations in Finland