



*Simon Ramo*

# SIMON RAMO

1913–2016

Founding Member of the National Academy of Engineering—1964

BY RONALD D. SUGAR

**S**IMON RAMO died June 27, 2016, at age 103 in his home in Santa Monica. He is frequently cited as the father of the US Intercontinental Ballistic Missile (ICBM) system and the founder of systems engineering.

Si was born May 7, 1913, to Clara and Benjamin Ramo in Salt Lake City. He received a BS degree in electrical engineering from the University of Utah, with highest honors, at age 20 and earned his PhD at the California Institute of Technology, magna cum laude, at age 23. He then joined General Electric Research Laboratories, where he accumulated 25 patents before the age of 30 and was cited as one of America's most outstanding young electrical engineers.

Pioneering in the generation of microwave electricity, Si was the first in the United States to produce microwave pulses at the kilowatt level and the first to create the so-called cavity resonator magnetron, an approach later fully developed by others to become the power source for World War II's microwave radar. He also developed GE's electron microscope.

His early definitive papers in the leading technical journals on waves in linear and rotating electron streams detailed the relationships among frequency, stream density, electron velocity, and amplification, earning him awards from physics and electrical engineering professional societies.

He published the first book on the characteristics of microwave electricity, *Fields and Waves in Modern Radio* (John Wiley, 1944), coauthored with John R. Whinnery, and in 1965, again with Whinnery, coauthored *Fields and Waves in Communication Electronics* (John Wiley). The latter became the classic textbook on the subject, with over a million copies sold. It is used in more than 100 universities and remains a leading text in the field.

After World War II Ramo joined Hughes Aircraft Company and launched an entirely new approach to defense electronics. He was vice president for operations over R&D, product engineering, and manufacturing. In a few years Hughes became one of the largest and most successful high-tech companies in the world. Developments at the company were basic to the air superiority of the United States and an extremely important contribution to national security.

Ramo left Hughes in 1953 with colleague Dean Wooldridge to found the Ramo-Wooldridge Corporation, later to become TRW and then part of Northrop Grumman Corporation.

At that time the USSR was well along in developing an ICBM that would be able to bypass the entire US air defense system. President Eisenhower placed the highest national priority on the United States' gaining an ICBM system before the Soviet Union. The Defense Department asked Ramo to be the chief engineer for the project, which was to become the country's largest.

A contract awarded to Ramo-Wooldridge for systems engineering and technical direction called for leading the development of both the missile and extensive flight test facilities in Florida and a supporting industry to supply the innovative components. The program called for unprecedented advances (10 times or more) in rocket propulsion, guidance accuracy, reentry heat containment, control precision, structures (payload to overall weight), and fuel performance, to name a few. Within five years, the US ICBM system had its first operational capability, ahead of the Russians.

Ramo later created Space Technology Laboratories (STL) as a subsidiary of Ramo-Wooldridge Corp., a year before the USSR's Sputnik launch. STL was the first US company to

receive a contract for a spacecraft from the newly established National Aeronautics and Space Administration (NASA). An STL spacecraft was the first both to reach the outer planets and to go beyond the solar system into far outer space.

Ramo held more than 40 patents, the last of which he received when he was 100 years old, making him the oldest patent holder in US history. One of his most recognized developments was systems engineering, which concentrates on the design and application of the whole as distinct from the parts, looking at a problem in its entirety, taking account of all the facets and variables, and linking the social to the technological. He wrote many articles about systems engineering, authored and coauthored a number of texts, and delivered numerous invited lectures at universities and National Academy and professional society meetings.

He served on the National Science Board, White House Council on Energy R&D, Advisory Council to the Secretary of Commerce, Advisory Council to the Secretary of State for Science and Foreign Affairs, and many advisory committees to the Defense Department and NASA.

He received numerous awards and honors, including the National Medal of Science (1979), bestowed by President Jimmy Carter for his pioneering work in electronics research and development. President Gerald Ford appointed him chair of the President's Advisory Committee on Science and Technology. In 1983 he received the Presidential Medal of Freedom, the nation's highest civilian award, from President Ronald Reagan. He was inducted into the Business Hall of Fame and in 1999 received the Lifetime Achievement Award from the Smithsonian Institution. He also received a number of honorary university doctorates.

At age 51, Si Ramo was the youngest founding member of the National Academy of Engineering. In 2013, coincident with his 100th birthday, the Academy named the Simon Ramo Founders Award (formerly the Founders Award) to honor an outstanding NAE member or foreign member who has upheld the ideals and principles of the NAE through professional, educational, and personal achievement and accomplishment.

In 1982 the Institute of Electrical and Electronics Engineers (IEEE) board of directors created the IEEE Simon Ramo Medal for exceptional achievement in systems engineering and systems science.

His books on science, engineering, and management are used in universities throughout the world and have been translated into German, French, Italian, Spanish, Portuguese, Russian, Japanese, and Arabic and republished in English in China, India, and Taiwan. And his *Extraordinary Tennis for the Ordinary Player* (Crown, 1970) holds the sales record for books on tennis.

During his career, and particularly in his later years, Ramo became a cherished mentor to dozens of upcoming scientists, engineers, entrepreneurs, and business executives. In addition he and his wife Virginia were generous philanthropists focusing on the sciences, arts, and education.

Ramo was married to Virginia (née Smith) for 72 years until her death in 2009. They are survived by sons Jim and Alan, four grandchildren, and three great-grandchildren.

