

## **Acceptance Speech on Induction to the Scottish Engineering Hall of Fame**

**James Watt Dinner, 6<sup>th</sup> October 2023**

Mr President, judges and all,

I was so surprised when I received the email from Gordon Masterton to let me know that I had been inducted into the Scottish Engineering Hall of Fame. There are so many great names: James Watt, Robert Napier, James Clark Maxwell, Alexander Graham Bell and of course many living inductees. Each year I listen with amazement at what each inductee has achieved and to the speeches from the living inductees, all surprised and honoured, as I am to receive this award.

When I left school, I did an HND in Electrical and Electronic Engineering, at what was then Napier College (now Edinburgh Napier University), It was a sandwich course which included 9 months of work in industry. I got married at the end of 2nd year and the college was surprised when I arrived at the start of 3rd year as they thought I would leave engineering – not only did I stay, but I got a distinction and 40 years later I'm back at Napier as a Royal Academy of Engineering Visiting Professor.

I then worked for Marconi Instrument. After 2 years I did an MSc in Digital Techniques and was asked to help on a digital project. This was my first time working on a digital design and I learnt so much from the other 2 engineers, including all about Programmable Logic – how to write code, how to program and erase the devices and how to test them.

I was then asked to research and implement a solution for an interface which had to be less than 1/3 of a board and I found a device called a Field Programmable Gate Array (FPGA). Using this I achieved the goal and in doing that I became the first person in Marconi to produce an FPGA design, to learn a new language called VHDL and to use all the associated tools.

Question: Hands up if you have heard of a processor ..... and an FPGA?

Here's how I like to describe them: When a post office receives a bag of letters a processor sorts them into postcodes. If the processor was then to deliver the post it would deliver them one by one at a very fast speed, but still only one at a time. An FPGA, although slower, would deliver all the postcodes in parallel, so mail is delivered quickly. In general, a processor is good for controlling data

serially and an FPGA is good at moving parallel data around at incredible speeds.

Question: Hands up if you have heard of Software ..... and Firmware?

While they are both programs, software is run on a previously designed processor whereas Firmware designs the actual hardware, with the FPGA being effectively empty until you download the programming file.

In my 40s I went back to university to do a full time Engineering Doctorate (EngD) and during this a patent was filed and Algotronix and I won several awards for a product which detected stolen Intellectual Property Cores using thermal analysis. I received my doctorate from the universities of Strathclyde, Glasgow, Heriot Watt, and Edinburgh – so I'm alumnus for 5 universities.

After the doctorate I returned to Leonardo (was Marconi, Ferranti, BAE etc) where I initially led just the firmware team but went on to be the Interim Head of Electronics Engineering leading over 300 engineers. I also became a Design Authority working with certification authorities to develop processes which ensured that our FPGA designs met the standards to be used in aircraft.

Over 40 years the functionality of FPGAs has grown exponentially, from about 4k transistors to 30Billion transistors. I have either designed or led teams that have designed over 200 FPGAs in products ranging from guidance systems, telecommunication monitoring equipment, radars, lasers and now to control electronically phased array antennas which communicate with satellites.

While I'm proud of what I have achieved as a leader and FPGA technical expert, I gained more from the EngD than just my degree and it really changed my life.

I was introduced to the Women's Engineering Society (WES) who were running a conference in Edinburgh in 2006 and I met 65 incredible women. After the conference I tentatively wrote to them and asked if I could join the council and luckily, they said yes. This started my volunteering career.

At WES I managed the Doris Gray Awards, distributing £10K annually for ten years in Scotland to women facing financial difficulties while studying engineering and supporting events which promoted engineering to women. I founded the Female Student Conference, raised funding to digitize the Women's Engineering Journal and was President from 2013-2014.

In 2012 I became a Fellow of the Institution of Engineering and Technology (IET) and started volunteering with the IET. I've was the first Chair of IET

Scotland, the IET Council and the Engineering Policy Group Scotland and I'm now a Trustee and Vice President as well as a Professional Registration Assessor and Interviewer and a Fellow Assessor.

I'm a Fellow and Trustee of the IES, Vice-President of the Royal Scottish Society of Arts (RSSA), board member of Engineering Scotland and the National Manufacturing Institute Scotland (NMIS), an Advisory board member of Association for Black Ethnic Minority Engineers (AFBE) and on the Hammermen of Edinburgh's Deacon's committee.

Finalizing my roles as a volunteer, I'm a STEM Ambassador, STEM champion at Napier, a mentor, a judge for many awards and I present as often as possible on both technical issues and events which promote engineering to women.

Last year I became Strathclyde University's Alumna of the Year and in summer this year I was awarded an Honourary Doctorate of Edinburgh Napier University. In 2020 I received an OBE for Diversity and Inclusion in Electronic Engineering.

I can't believe the amazing things that have happened since my HND, the people I've met from inspiring children, brilliant engineers, politicians to the Royal Family, including King Charles. I've attended so many amazing events including being a special guest at the Edinburgh Tattoo, Professor Peter Higgs Edinburgh Medal Ceremony, a Jubilee celebration for Queen Elizabeth and many fantastic dinners, like the dinner tonight.

Finally, I would like to again thank Gordon Masterton and all the Hall of Fame judges for inducting me into the Hall of Fame, it truly is an honour.

**Dr Carol Marsh OBE**