Opening Remarks by Savvas Chamberlain ahead of the first Waterloo Symposium on Technology & Society

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Balsillie School of International Affairs
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Thank you, Mark

Good evening

First, I like to tell you how this Waterloo Symposium on Technology & Society series was conceived. Then I shall give you a brief history of the Semiconductor revolution which is fueling these technological innovations and advancements in our society.

The Waterloo Symposium on Technology & Society seeks to promote public discussion in Canada and beyond on the societal challenges and opportunities created by innovations in four primary areas. Robotics, Artificial Intelligence, Big Data and Social Media.

Due to my speech disability you may have difficulty in clearly understanding me. I shall give my speech to Mark to put it on the Symposium Web site.

About a year ago Mark and I had lunch at a restaurant in Waterloo.
We started discussing income inequality which was highlighted in the excellent books by the late economist Thomas Piketty.

Over the past 30 years there were significant technological advancements and innovations in the areas of Robotics, Artificial Intelligence, Large Data, Multi Media, and Quantitative and Synthetic Biology. We both agreed that presently there is not much debate in our society about the effects of such rapid technological developments on the different sectors of our population in our Canadian Society.

It is well accepted now that there will be, in addition to the potential positive gains to the GDP, there will be potentially very significant negative effects on some sectors of our population. This Symposium series of lectures and discussions attempts to initiate discussion and response and possibly influence federal and provincial policies going forward.

If we look at the history of technological innovations, until about the early 1990's technological innovations and advancements benefited and raised the standard of living of all sectors of our population in our societies. However, since the early 1990's there is a consensus of the top world economists that these rapid technological advancements benefit substantially the top 1% of our society. A very small benefit trickles down for the rest of the population.

It is my opinion that these technological innovations were the result of the inventions of the monolithic integrated circuit and planar process around 1958 by Robert Noyce (Fairchild Semiconductor), Jack Kilby (Texas Instruments), Kurt Lehovec (Sprague Electric Company) and Jean Hoerni (Fairchild Semiconductor).

The billion-transistor integrated circuits of today rely on Hoerni's breakthrough planar technology idea. Before I go to the microprocessor let me talk a bit about Moore's law.

In 1965 Gordon Moore observed that the number of transistors on a silicon chip will double every 18 months. The speed of the transistors will double while the cost of the silicon integrated chip will decrease. This deduction by Moore after few years turned out to be correct. Meanwhile the Semiconductor industry started believing and implementing in its Semiconductor Association a road map based on this observation and referring to it as Moore's Law. This started the semiconductor revolution.

Let me now tell you, how this revolution started.

In March 1971 under the leadership of Robert Noyce at Intel Corporation, Intel delivered to Busicom the first commercially available microprocessor, 4004, the chief designer of this microprocessor was Federico Faggin. The

silicon chip had 2,300 transistors. By 2010 the Intel Core silicon chip processor, fabricated on the 32 nm process, had 560 million transistors. Other microprocessors were introduced after that with some of the silicon chips in 2014 having more than a billion devices on the same chip. The growth in computer power continued at an exponential rate with the computing costs coming down about the same rate.

In 1975 the cost of computing for an IBM main frame, for 1 million instructions per second was $1Million dollars, in 2000 with Intel Pentium 4 chip the cost was $1.00. Presently (2019) the cost of 1 million instructions per second computing capability is in the fraction of a cent range.

Of course, a lot of you remember the introduction of the IBM personal computer on August 12, 1981.This IBM personal computer was affordable by the masses.

We can safely conclude that the introduction of the microprocessor 48 years ago caused the present revolutionary technological advancements. The exponentially decreasing cost of computing enabled many technologies to advance rapidly.

Turning back to the Moore's law, despite my speech disability, my professional career grew during the Moore's law period, and of course I benefited from these advancements. In 1968 I designed a 10X10 image sensor having approximately 500 transistors on the same silicon chip. When we were forced to sell DALSA Corp on February 12, 2011, DALSA had a silicon image sensor with more than 50 million devices on the same silicon chip.

This symposium series is held in our KW community where it can rightly claim that this technology community took part in some of these technological advancements.

Some of you in this audience also participated in the advancement of these technologies and the computer evolution. I shall briefly tell you what I remember about it.

In 1967, under the leadership of the first Dean of Mathematics, Prof David Sprott, the University of Waterloo acquired the IBM 360/75; this IBM computer model was, in 1969, the first modern computer in the world. The UW faculty of Mathematics was the first of its kind in North America and perhaps the first through out the world in pioneering Computer Science. Paul Dirksen and Paul Cress wrote the WATFOR 360 compiler which, under the then leadership of Wes Graham, became the WATFIV compiler for the IBM360 computer which was then used throughout the world.

Other contributions include, in 1999, the invention and development of the Blackberry by Mike Lazaridis, led to the present evolution of the smart phone. In 2001-2002 DALSA Corp of Waterloo provided to NASA the image sensor for the camera used on the Mars Rover. This gave us for the first time pictures from Mars.

Back to Moore' law again. Earlier I mentioned 2014. Well, the Semiconductor Association declared the death of Moore's law at the age of 51.

Technological innovations will continue with the advent of affordable supercomputers and we shall see that more unthinkable applications will materialize.

However, we should not have illusions that the innovations and technological advancements will now cease. Innovations of inclusion of MEMS on the same silicon planar chips is well on it way. They now incorporate on to the same silicon chip microprocessors, memory, logic and additional MEM sensor devices. New applications employing cheap computing will proliferate at a tremendous rate.

Back to our symposium: The debate we like to initiate in our Ontario society and Canada is to how, and what can we do, so that the benefits of these innovations and technological advancements accrue also to the entire population and not just to the top 1%.

With respect the Robotics technological advancements, Dr. Martin Ford did extensive study to address these concerns. I shall now pass it to Mark Sedra to Introduce Dr. Martin Ford for tonight's lecture.

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