

“REVOLUTION 4.0”

by Michele Buono

MILENA GABANELLI IN STUDIO

Let's begin with the industrial revolution which is rapidly changing the world of employment as we know it today. Some call it the moving train.

You either jump on it or you are left behind. Michele Buono.

MICHELE BUONO VOICE OVER.

The streets of Nevada. If the driver of this lorry removes his hands from the wheel, sticks on the auto pilot, plans his route and decides whether to rest or take a look at his work schedule, can we still call him a truck driver?

JORG HOFMANN - CHAIRMAN IG METALL AND SUPERVISORY BOARD DAIMLER

The important thing is that technology revolves around man. In this case training is required for more highly qualified truck drivers. They will have to deal more with the organisation of transport than driving, the roads will be safer because truck drivers will no longer need to sit behind the wheel for hours on end.

MICHELE BUONO VOICE OVER.

While the State of Nevada was issuing Daimler with a license to use autonomous trucks on the roads, some secondary school pupils from Trento are leaving for the Far East with a robot in their suitcases. Bye guys.

MICHELE BUONO VOICE OVER.

New York. At Associated Press articles are coming out that have been automatically generated by a machine.

ADAM SMITH – CHIEF REVENUE OFFICER AUTOMATED INSIGHTS

The software analyses the data and creates a plan, just as if an analyst or a journalist studies the data and says: "here is the story".

LISA GIBBS - BUSINESS EDITOR ASSOCIATED PRESS

I think it is important to point out that it is humans that insert the information that the programme transforms into articles. With this system we have increased our news output capacity from 300 to 4200 articles a month.

MICHELE BUONO

Has anyone been made redundant?

LISA GIBBS - BUSINESS EDITOR ASSOCIATED PRESS

No. Associated Press has not made anyone redundant, it has only modified existing roles.

ANDREW McAFEE - CENTER FOR DIGITAL BUSINESS MIT BOSTON

We are entering a new era. Artificial intelligence, networks, connectivity, combined with two centuries of industrial development, represent a completely new chapter in the history of the economy.

ERIK BRYNJOLFSSON - CENTER FOR DIGITAL BUSINESS MIT BOSTON

This revolution is as big as the first industrial revolution, McAfee and I call it “the second age of machines”.

MICHELE BUONO VOICE OVER.

Will we go the way of horses? The two economists have asked themselves this question, however. Replaced by the telegram, trains, internal combustion engines...

ANDREW McAFEE - CENTER FOR DIGITAL BUSINESS MIT BOSTON

It's true! The demand for work horses fell so quickly that by the middle of the 20th century we no longer considered them part of the economy because they had become irrelevant. For this reason we wanted to study human work and horse work.

MICHELE BUONO VOICE OVER.

In the Robert Bosch factories in Bavaria the machines speak with employees.

STEPHAN MAYER – BOSCH SITE MANAGER - BLAIBACH

Every day at the end of the shift the machines send us an email with a list of data: for example, that there is a shortfall of 200 pieces in our daily production forecast. All of our factories across the world receive the same data in real time so we can more easily pinpoint where the problem lies.

MICHELE BUONO VOICE OVER.

So you can control production even when you aren't in the office?

STEPHAN MAYER – BOSCH SITE MANAGER - BLAIBACH

Sure, all you need is a smartphone or a tablet. The advantage is that we can optimise production at global level. Before, it took days to gather this information. Now all you have to do is press a button and in the morning we can get straight to work taking decisions.

MICHELE BUONO VOICE OVER.

Hello I Cub! Where is the octopus?

I CUB

I think this is the octopus!

ROBERTO CINGOLANI - SCIENTIFIC DIRECTOR, ITALIAN TECHNOLOGY INSTITUTE

In this machine prototype, in this technology prototype, modern industry acts as the supply chain of future production. But think about the people that programme these machines, but also those that educate them because if the machine has the intelligence to learn how to work in a specific situation it will probably have a teacher, just like children at school.

ERIK BRYNJOLFSSON - CENTER FOR DIGITAL BUSINESS MIT BOSTON

I really don't think we will go the way of horses, we are in a better position: we can decide how to organise the economy, horses can't.

MILENA GABANELLI IN STUDIO

And it's not as if it was all bad news for horses, we freed them from having to pull heavy weights. Just like the first industrial revolution freed workers from

inhumane conditions. Then automation and electronics came along and we are still exploiting the effects of those innovations. And, according to experts in economic systems, we cannot grow any further. But we can if we radically modify the system because we will gradually change everything, from production centres to social organisation and construction, which will be adapted. And so what will happen in the fourth industrial revolution, that of intelligent systems and interconnection?

MICHELE BUONO VOICE OVER.

It was the years of the Twist when the Fedegari brothers had a brainwave at Pavia Hospital. While repairing a sterilisation autoclave they said to each other: "We can make these ourselves, and better". This was how these tinsmiths became entrepreneurs in the field of autoclaves for the pharmaceuticals industry. They brought in new workers to teach the trade to and increasingly modern machines followed. Then along came their children, who saw things in the same way.

GIUSEPPE FEDEGARI – VICE CHAIRMAN FEDEGARI AUTOCLAVI SPA

If you invest in training your staff, after years you have employees that are able to do jobs that those who haven't made the same investments in their staff will never be able to do.

MICHELE BUONO VOICE OVER.

In fact, they weren't caught off guard when automation arrived in the 1980s. They believed in it right away. Sterilisation autoclaves are manufactured full of welding joints. The majority of these are now carried out by robots.

GIUSEPPE FEDEGARI – VICE CHAIRMAN FEDEGARI AUTOCLAVI SPA

Certainly an increase in productivity...

MICHELE BUONO

And what does an increase in productivity mean for a company?

GIUSEPPE FEDEGARI – VICE CHAIRMAN FEDEGARI AUTOCLAVI SPA

A chance to enter different markets with higher quality products.

MICHELE BUONO

And the people that used to do the soldering by hand? What do they do now?

GIUSEPPE FEDEGARI – VICE CHAIRMAN FEDEGARI AUTOCLAVI SPA

They work on the robots or other automatic machines.

MICHELE BUONO

How many workers?

GIUSEPPE FEDEGARI – VICE CHAIRMAN FEDEGARI AUTOCLAVI SPA

It has gone up.

MICHELE BUONO VOICE OVER.

Then, in the 1990s industrial processes were digitalised.

WORKER

Now we are analysing the material and in 30 seconds we have finished the complete chemical analysis of the steel that the incoming piece is made of and the material is compliant with what's written on the certificate.

MICHELE BUONO

So it is suitable?

WORKER

It is suitable.

MASSIMO GHELFI - HEAD OF AUTOMATION FEDEGARI AUTOCLAVI SPA

All of the welding joints you can now see become digital information that is collected in real time by our servers in our clouds.

RICCARDO BOATTI – HEAD OF QUALITY FEDEGARI AUTOCLAVI SPA

And we can get a clearer idea of their quality.

MICHELE BUONO VOICE OVER.

The industrial processes generate data that is turned into files. If you share them between producers, suppliers and customers, one of the advantages is being able to personalise the products; and produce as many as required.

GIUSEPPE FEDEGARI – VICE CHAIRMAN FEDEGARI AUTOCLAVI SPA

You haven't got a warehouse of products to sell but it is a challenge because you have to continuously look for individual customers for each single product.

MICHELE BUONO VOICE OVER.

By simulating production processes, the creation of a prototype of a robot capable of processing single batches of medicines is faster.

MASSIMO GHELFI - HEAD OF AUTOMATION FEDEGARI AUTOCLAVI SPA

This means that companies, also smaller farms, start-ups, can enter the market and produce specific drugs for illnesses that are not perhaps currently catered for by the large-scale industry.

GIUSEPPE FEDEGARI – VICE CHAIRMAN FEDEGARI AUTOCLAVI SPA

Every contract we fulfil requires a number of man hours at a higher level of development compared with the past, and so we need more designers in order to build more complex plants.

MICHELE BUONO VOICE OVER.

One of the effects of the fourth industrial revolution is that you can produce your machines in Italy, sell them all over the world and guarantee your customers complete assistance without anybody having to move anywhere. All you need is sensors on all the machines and products, and suitable applications. Red indicates that there is a problem with a valve on a plant in China.

MASSIMO GHELFI - HEAD OF AUTOMATION FEDEGARI AUTOCLAVI SPA

The operator in China directly accesses the machine documentation.

MICHELE BUONO VOICE OVER.

And a video to guide him.

CAMILLO GHELFI - FEDEGARI AUTOCLAVI SPA

When the maintenance work is complete the level of wear and tear of the valve is such that it is ready for regular use again. We managed to do all this from Pavia for China using network and cloud infrastructure.

MICHELE BUONO VOICE OVER.

What is the financial result?

GIUSEPPE FEDEGARI – VICE CHAIRMAN FEDEGARI AUTOCLAVI SPA

Ten years ago our turnover was around 25-30 million euro and we had around 200 staff. Now our group turnover is around 60 million euro, we have approximately 400 employees in our various sites across the world, 300 of which in Italy.

ROBERTO MAIETTI – INDUSTRIAL STRATEGIES CONSULTANT

The error we made in the past was thinking only in terms of labour costs and not productivity.

MICHELE BUONO

When fully operative in Italy, how much could this production system be worth?

ROBERTO MAIETTI – INDUSTRIAL STRATEGIES CONSULTANT

Looking ahead, we could be looking at as much as 25%.

MICHELE BUONO

And as regards employment?

ROBERTO MAIETTI – INDUSTRIAL STRATEGIES CONSULTANT

There will be a positive balance first and foremost in terms of salaries because there will be more important and better qualified professional figures who will be paid better. From a purely quantitative viewpoint, I'm not totally convinced that this will lead to a reduction in the workforce because the fact that we are moving towards new services and products may also result in the further development of businesses.

MICHELE BUONO VOICE OVER.

When they started out in the 1920s there were 9 of these mechanics from Imola. They fixed farming machinery and then they learned how to construct it directly and never looked back. In the 1970s there were 200 of them and they had also expanded to machines for the food and ceramics industries. Now the company has 1085 employees. And the rest of the group?

PIETRO CASSANI - GENERAL MANAGER SACMI

We have gone from 1000 people to 4200 people globally.

MICHELE BUONO VOICE OVER.

There aren't many people on the production line.

PIETRO CASSANI - GENERAL MANAGER SACMI

We train them, we develop them, we allocate them to more complex activities.

PIETRO CASSANI - GENERAL MANAGER SACMI

For example, they write the software that runs the machine tools.

CLAUDIO SABBIONI - SACMI

During the day we monitor the work, we test the prototypes of the new pieces, and during the night we launch them, we leave them to work when there is no operator.

MICHELE BUONO

What are the advantages?

ANDREA ZUFFI - HEAD OF MACHINE TOOLS SACMI

This machine is able to carry out every kind of job.

PIETRO CASSANI - GENERAL MANAGER SACMI

We can produce whatever the customer requests without increasing the cost so, depending on market demand, we can convert a workstation into various different kinds of machine.

MICHELE BUONO VOICE OVER.

No surplus and predictive maintenance: i.e. customers are notified when machines are about to break down.

MASSIMILIANO BARIZZI - SACMI

We are able to understand wear and tear times, which machine stops the line most often. We can see the list of alarms when anomalies begin to crop up and therefore take action before the machine breaks down.

MICHELE BUONO VOICE OVER.

For this company, kilometres away, this means no downtime and no losses. Ceramics are produced here.

GIOVANNI GROSSI – FINANCE DIRECTOR FLORIM

There has been a constant improvement over the years thanks to all the investments we have made, over 200 million in the last 5 years, our gross margin has gone from 24 million in 2008 to 83 million in 2014.

MICHELE BUONO VOICE OVER.

This centre in the countryside of Treviso distributes clothes.

DANIELE FREGNAN - LOGISTICS DIRECTOR BENETTON

We manage 120 million garments a year here. Large volumes that are managed in limited timeframes and that require a great deal of synchronisation.

MICHELE BUONO VOICE OVER.

Smart cash registers in the stores analyse the warehouse and the garments sold in terms of type, colour and size.

MATTEO MENTESSI – AREA MANAGER BENETTON

Here, for example, I see that 14 M's of this jumper have arrived. 4 pieces have been sold in the last week and I can already see that 3 of these jumpers in this size have been ordered and will arrive from the warehouse in a few days.

MICHELE BUONO VOICE OVER.

The data is transferred from the entire sales network to the head office which is responsible for replenishment and which understands how to plan production for the following year and avoid downtime. The items produced by the centres across Asia and Europe all arrive here. Now the work consists of reorganising them and sending them to the 5500 stores in 100 different places in the world. A camera reads a barcode containing the item's data and sorts it. Every chest is a store.

DANIELE FREGNAN - LOGISTICS DIRECTOR BENETTON

The final label is attached to a box and the packaging process is finished.

MICHELE BUONO VOICE OVER.

The heart of the system is the automatic warehouse which moves boxes from 800,000 positions for 120 million garments a year. Along the supply chain there are expertise and jobs that didn't exist until 10 years ago.

NICOLA DELLE FOGLIE - BENETTON

I worked at a dye-works and after undergoing in-house training I am now able to this job here.

MICHELE BUONO VOICE OVER.

Here, activities are monitored to ensure that every box heads off in the right direction.

MICHELE BUONO

Who developed this software?

NICOLA GRANZIERA - BENETTON

We created it. The IT electrical engineering department.

MICHELE BUONO VOICE OVER.

And no longer has anyone had to carry boxes on their shoulders and push the trolleys by hand.

NICOLA GRANZIERA - BENETTON

In the end we have to use our hands less and therefore less muscle, and we have to use our brains more in research.

MICHELE BUONO VOICE OVER.

Every lorry is registered and is called to the bay on the basis of its load capacity in such a way that vehicles always travel with a full load.

DANIELE FREGNAN - LOGISTICS DIRECTOR BENETTON

Of course, this also has environmental as well as economic consequences.

MICHELE BUONO VOICE OVER.

How can we transform Italian industry as a whole in this way?

ENNIO LUCARELLI - CHAIRMAN CONFINDUSTRIA INNOVATIVE AND TECHNOLOGICAL SERVICES

Well, in reality Industry 4.0 was already launched a few years back in Germany and the US so we are already playing catch-up.

MICHELE BUONO VOICE OVER.

Yet if you go to any research centre in Italy they explain things very clearly to you and even tell you how it can be done. Milan Polytechnic - engineering management.

GIOVANNI MIRAGLIOTTA - MILAN POLYTECHNIC OBSERVATORIES

This is a simulation of an entire production line that goes from the manufacturer, so we see a line end, through to the post-sales assistance.

MICHELE BUONO VOICE OVER.

What needs to happen for this system to take off?

GIOVANNI MIRAGLIOTTA - MILAN POLYTECHNIC OBSERVATORIES

We need connectivity, bandwidth.

MICHELE BUONO

Is it sufficient in our country, Italy?

GIOVANNI MIRAGLIOTTA - MILAN POLYTECHNIC OBSERVATORIES

We already know the situation. In terms of megabits, seconds, coverage and air, Italy is well behind other countries with which our manufacturing companies have to compete. The second type of infrastructure, for me very different, is a cultural infrastructure. We have to introduce, to both manufacturing and non-manufacturing Italian companies, the ability to understand that future competition will above all be based on the capacity to view digital technologies as a way of restoring efficiency and competitiveness.

MICHELE BUONO VOICE OVER.

As such, more intermediate structures are required to act as a bridge between research and business.

MICHELE BUONO

Have these been planned?

ROBERTO CRAPELLI – CEO ROLAND BERGER ITALIA

I don't know to what degree these have been developed. They are certainly on the agenda and the to-do list.

MICHELE BUONO VOICE OVER.

In 2014 the Department of Economic Development called international consultancy firm Roland Berger and a group of professors in order to understand the fourth industrial revolution.

MICHELE BUONO

Are businesses automatically able to equip themselves with these new technologies and a suitable structure on their own?

ROBERTO CRAPELLI – CEO ROLAND BERGER ITALIA

No. There are three actors: the shareholders and entrepreneurs, the financial world in general which must provide help, and of course the public, which must demand industrial policies that promote this phenomenon.

MICHELE BUONO VOICE OVER.

In other words, the consultants tell the Department of Economic Development that nothing will happen unless there is an industrial policy. Has Confindustria taken any action?

ENNIO LUCARELLI – CHAIRMAN CONFINDUSTRIA INNOVATIVE AND TECHNOLOGICAL SERVICES

It is vital that human resources are trained for the world of the future, not the world of the past. This requires a major transformation and a major acceleration on the part of our university system.

MICHELE BUONO

Has the Department of Education and Scientific Research been involved in the Italian Government task force that is monitoring this industrial revolution?

ROBERTO CRAPELLI – CEO ROLAND BERGER ITALIA

We are not currently involved with the part of the task force that deals with interaction with other Departments so I couldn't tell you exactly how and to what degree the Research Department, for example, is involved.

MICHELE BUONO

Does the Department of Education and Scientific Research embrace Industry 4.0? Does it want to play ball?

ENNIO LUCARELLI – CHAIRMAN CONFINDUSTRIA INNOVATIVE AND TECHNOLOGICAL SERVICES

We haven't met with them.

MICHELE BUONO VOICE OVER.

Berlin. In Germany the Industry 4.0 strategy was launched in 2011. The Department of Education and Research immediately began to work with Industry, Finance, Employment, the Home Office and Healthcare.

WOLF-DIETER LUKAS – GERMAN DEPARTMENT OF EDUCATION AND RESEARCH

Because you cannot focus solely on digital technology or the manufacturing industry. At this moment in time politics, science and industry have to work together.

MICHELE BUONO

How much funding was allocated for the project?

WOLF-DIETER LUKAS – GERMAN DEPARTMENT OF EDUCATION AND RESEARCH

Initially 200 million euro, divided between Finance and Education. Now it has increased and Education and Research alone has already received around 200 million.

MICHELE BUONO

What is your role at the moment?

WOLF-DIETER LUKAS – GERMAN DEPARTMENT OF EDUCATION AND RESEARCH

To make sure that jobs aren't lost and that new ones are created. Because the type of work will change. And so it is necessary to organise teaching and professional updating in an appropriate way.

MICHELE BUONO VOICE OVER.

What else did you say to the Department of Economic Development?

ROBERTO CRAPELLI – CEO ROLAND BERGER ITALIA

Machinery, automation, software, digitalisation and other complex things along the supply chains. The point isn't that new money is required. We need to reinvest or reallocate money, capital that is available in the world. There is a lot of liquidity in the world. Liquidity goes where there is less risk or where there are better returns. In this way and if there is some direction, a narrative behind the country's economy, it is attractive because the economy is industrial.

MICHELE BUONO

What did they say to you?

ROBERTO CRAPELLI – CEO ROLAND BERGER ITALIA

That at the moment it is in the hands of the Department which is working, taking the next steps so it can likely become a tool ready to be implemented. At the present we don't have detailed knowledge of this roadmap which will be fine-tuned in order to enact this policy.

ENNIO LUCARELLI – CHAIRMAN CONFINDUSTRIA INNOVATIVE AND TECHNOLOGICAL SERVICES

If I'm not mistaken this task force was set up a year ago. A year has passed and we still haven't seen the results.

MICHELE BUONO

The Department of Economic Development says they are working, making progress.

ENNIO LUCARELLI – CHAIRMAN CONFINDUSTRIA INNOVATIVE AND TECHNOLOGICAL SERVICES

But others are moving much more quickly. And so if we don't measure ourselves at international level, and sooner or later we have to measure ourselves at international level, otherwise we risk stepping out of line with what the rest of the world is inventing and getting lost. If we miss the train of the digital revolution we have lost, we will be no more and others will take our place.

MILENA GABANELLI IN STUDIO

Others will take over. And so the paradox of our time is that there is excess liquidity and not enough viable investments: even **Draghi** has said that it isn't enough to fill the banks with money. We need the right industrial project to attract private capital. And we don't yet have such a project. Half of our businesses don't know how to innovate their industrial processes. We have created a working group in Rome we call the task force, we say "we are working on it", but we aren't involving entrepreneurs or research. And if we take the most recent strategic and digital planning document there isn't a single word on

manufacturing. OK, after the break we'll see how German and American manufacturing is being reorganised.

BREAK

MILENA GABANELLI IN STUDIO

Let's return to the 4.0 revolution. The world is changing and perhaps we'd all like to adapt. But if you decide to only communicate via email while your contacts continue to use paper, you'll end up alone in front of your computer. The same kind of thing is happening with the new revolution: without intermediate structures, businesses can't manage on their own. Let's start with Germany whose well-known efficiency has been somewhat tainted by the Volkswagen emissions scandal. They'll be paying damages that they won't forget for a long time. But this doesn't have any bearing on the organisation of their economy. Let's see.

MICHELE BUONO VOICE OVER.

The German Government has set itself the goal of redesigning the entire industrial system according to these standards.

RUPERT HOELLBACHER – BOSCH SITE MANAGER - BLAIBACH

We produce ABS and ESP electronic systems for the stability of cars. The main platform is here and we manage another ten plants across the world, which are all connected.

ULDERICO VACCA – ABS ESP DEPARTMENT MANAGER BOSCH – BLAIBACH

At any given moment we can ask the system for smart reports that allow us to compare the performances of the various lines, understand what problems we have on a line and how they have been solved on other lines. We can therefore make the same improvements on our lines and exponentially multiply the speed of the improvement in the performance of our lines.

MICHELE BUONO

And how do you manage to monitor all of the plants?

RUPERT HOELLBACHER – BOSCH SITE MANAGER - BLAIBACH

I have them on my smartphone and, like me, every manager and employee all over the world can compare the work of different lines. It is the quickest way of solving a problem.

HARALD WETZEL - BOSCH SITE - BLAIBACH

Workers no longer walk around the departments and warehouses to update the files.

ULDERICO VACCA – ABS ESP DEPARTMENT MANAGER BOSCH – BLAIBACH

Our lines are highly automated. There are around 40 stations on each line. Almost all stations have a robot in order to increase productivity and speed. And also to reduce our operators' workload.

MICHELE BUONO

And what do the workers do?

ULDERICO VACCA – ABS ESP DEPARTMENT MANAGER BOSCH – BLAIBACH

We have two levels of workers: machine operators, who support the work of the machine with the loading and unloading of the main components, and more specialised manual workers that manage the functions of the machines and ensure that they produce in accordance with the established standards.

BENEDIKT BAUMBACH - BOSCH SITE - BLAIBACH

If there is something that doesn't work in one of the pieces we produce we can use a scanner to immediately establish the status of the tools that constructed it, the type of maintenance required and the timeframe. We can see where they are located in the factory and, if necessary, quickly recall and repair them.

MICHELE BUONO

What impact does this type of organisation have?

RUPERT HOELLBACHER – BOSCH SITE MANAGER - BLAIBACH

Production costs have fallen.

MICHELE BUONO

What are the economic figures?

RUPERT HOELLBACHER – BOSCH SITE MANAGER - BLAIBACH

Since we began to adopt these systems, over two years ago, we have recorded two-figure productivity factors every year.

MICHELE BUONO VOICE OVER.

They have managed to safeguard jobs, increasing the number of more highly-qualified, better-paid jobs. Now the aim of the Union is to increase industrial output to 20% of the GDP. German production is worth around 23%.

THOMAS RINN - ROLAND BERGER - GERMANY

We have to work to maintain this position.

MICHELE BUONO

Why is it at risk?

THOMAS RINN - ROLAND BERGER - GERMANY

If businesses don't adapt they become less profitable and when this happens, markets and jobs are lost.

MICHELE BUONO

What steps is the German Government taking?

THOMAS RINN - ROLAND BERGER - GERMANY

It has understood that Industry 4.0 is more about the future than pretty words, and the issue is on the agenda.

MICHELE BUONO VOICE OVER.

The future consists of smart machines that follow the orders of the raw material, construct me like this and like that, make me red or yellow, give me this optional extra. There are just a few workers around to monitor the processes; rather, they are involved in design, marketing, logistics and customer services.

SUSANNE KUNSCHERT – MANAGING PARTNER PILZ GMBH

Machines must now have a brain that is immediately able to read the information. Can you see how they are flashing? That is because they are thinking.

MICHELE BUONO

In this project the Government also involved industrialists from the start. But what did they actually ask you?

SUSANNE KUNSCHERT – MANAGING PARTNER PILZ GMBH

They asked me to involve SMEs because they don't want the change only to be driven by major multinationals.

MICHELE BUONO VOICE OVER.

In fact, it isn't enough that the Government merely launches a project, perhaps even solidly financing it. Intermediate structures are also required.

ECKHARD HOHWIELER – FRAUNHOFER INSTITUTE BERLINO

Our role is to develop research projects on the collaboration between men and machines and men and robots, and then transfer them to businesses.

MICHELE BUONO VOICE OVER.

Berlin. Fraunhofer Institute. There are 66 centres like this one in Germany. They are financed by the State, the regions and businesses.

GERHARD SCHRECK – FRAUNHOFER INSTITUTE BERLINO

This is a collaborative robot. Its name is Kobot. It is a system that increases power: a sensor recognises the strength of the person working it and multiplies it. It is possible to lift a 700 kg car with just one hand!

MICHELE BUONO

And these guys?

ECKHARD HOHWIELER – FRAUNHOFER INSTITUTE BERLINO

They are students that actively participate in the projects. They study mechanical engineering, production technology, computer science and even economics. We hire them on part-time contracts of 80 hours a month so they can learn also by working alongside companies.

STUDENT

I am studying the thermal behaviour of this robot. The problem with this system, which is designed to mill and sharpen, is its precision, which depends on many factors, including its thermal behaviour.

ECKHARD HOHWIELER – FRAUNHOFER INSTITUTE BERLINO

When these students have finished their studies they join a company and develop a network with us, made up of their knowledge.

MICHELE BUONO VOICE OVER.

Centre for research on Artificial Intelligence. Here it is possible to simulate entire production processes.

WOLFGANG WAHLSTER – SCIENTIFIC DIRECTOR ARTIFICIAL INTELLIGENCE RESEARCH CENTRE

We are a public-private company formed of 22 businesses associated with the Department of Education and Research and the regions. On their own, businesses struggle to apply innovation and the science is too theoretical. So we are there to act as a bridge.

MICHELE BUONO VOICE OVER.

A way of giving everyone the chance to test out new technologies and design their own factory.

DETLEF ZUHLKE – DIRECTOR SMART FACTORY - KAISERSLAUTERN

For example, I switch on and switch off, like I was using my printer at home. Engineering obligations are therefore reduced and it is possible to react quickly to market changes with a notable cost reduction.

MICHELE BUONO VOICE OVER.

IG Metall, Frankfurt. The strongest trade union in Germany, the metalworkers' union.

JORG HOFMANN - CHAIRMAN IG METALL

This is a train we mustn't miss because if we don't get on board it will just carry on without us.

MICHELE BUONO VOICE OVER.

So you have nothing against the hyper-robotisation of industry?

JORG HOFMANN - CHAIRMAN IG METALL

Look, I sit on the committee of the Department of Finance, that of Education and Research, and we are also represented on the Employment committee. This is to highlight the fact that since the outset, we, as a union, have managed to transform Industry 4.0 from a purely technological project into a project on the future of employment.

MICHELE BUONO VOICE OVER.

A future that has taken shape. This is SAP. Here, software for businesses is developed. The company has more than 70,000 staff across the world. And the majority are not computer engineers. In the city of Waldorf there is zero unemployment also thanks to the presence of this company and the jobs it generates.

NILS HERZBERG - SAP

Let's take Keiser, they don't want to sell their compressors anymore but take them to their customers to get them to use them. Just like at home; my children don't want CDs anymore but they want to listen to music. You can do the same thing with a compressor. To issue an invoice all I need to know is how many cubic metres of air it produced. It is like the electricity that comes from an electric socket. You don't need a power station for every home. Even multinationals want to use rather than possess now. To do this we have to develop a model for a huge amount of data.

MICHELE BUONO VOICE OVER.

The model, in the form of software, is then placed in the cloud, a warehouse that many different customers can access.

NILS HERZBERG - SAP

Economically it doesn't make sense for everyone to work independently. This is why shared technologies are used.

MICHELE BUONO VOICE OVER.

I typed in "United States" and "smart manufacturing". A few days later I am travelling over North Carolina. It is a place that you immediately associate with tobacco and the Blues. It is one of the states to have been hardest hit by the recession. Unemployment is still high but it is getting back on its feet.

BARACK OBAMA -

Thanks to the quality of this university, companies like Cisco and IBM are opening new sites here and continue to hire new staff.

MICHELE BUONO VOICE OVER.

The formula now is to strengthen public universities and research so they support businesses and foster trade.

BARACK OBAMA

I told Congress that we need at least 15 hubs like this one. With the goal of reaching 45 across the US! In the meantime I can announce that a high-technology centre for producing a new generation of semiconductors is about to be opened in Raleigh, North Carolina! This is fantastic news!

MICHELE BUONO

Other Presidents have pushed manufacturing outside the US, now you are bringing it back home?

PAUL COHEN – INDUSTRIAL ENGINEERING NORTH CAROLINA STATE UNIVERSITY

Yes, it is something of a turnaround. I was struck by the general enthusiasm around the President's speech. I have dedicated my career to smart manufacturing, it is something I have always believed in. The most exhilarating thing is that it is involving universities, professional training centres, businesses and non-profit organisations.

MICHELE BUONO VOICE OVER.

The reason is this: public universities are funded by public money and therefore belong to everyone. If you celebrate them rather than neglect them, businesses will come to the campuses because they will find researchers to develop their projects there.

PAUL WESTMORELAND - CHEMICAL ENGINEERING - NORTH CAROLINA STATE UNIVERSITY

Mann+Hummel is German and has opened here a research centre on purification. Spanish company Grifols, active in the biomedical field, has arrived too and there is an advanced Government analysis laboratory and the analytical sciences unit. This proximity is enabling them all to grow.

MICHELE BUONO VOICE OVER.

Cisco System came to North Carolina because it has a good university. A certain Robbie Allen went to work there and would go on to invent a piece of software that would revolutionise the work of journalists.

ADAM SMITH – CHIEF REVENUE OFFICER AUTOMATED INSIGHTS

We created a programme for the automatic processing of language, a platform that acquires data and transforms it into a text that appears to have been written by an analyst or journalist.

MICHELE BUONO VOICE OVER.

When they told people about it there was a lot of concern. What will happen to the journalists? Then The Associated Press adopted the system in 2014 and nobody was fired.

LISA GIBBS - BUSINESS EDITOR ASSOCIATED PRESS

Many people still define this phenomenon as “robot journalism”. But the great thing is that it was our journalists that felt like robots when they had to churn out financial report after financial report on companies. They viewed it as a thankless task but now they have more time for investigative journalism and for more creative writing.

MICHELE BUONO VOICE OVER.

The software processes the data - for example, financial reports, stock exchange trends, sports results - and organises it in a text that already has the semblance of an article, in real time.

ADAM SMITH – CHIEF REVENUE OFFICER AUTOMATED INSIGHTS

Journalists and editors add colour, context and elements that aren't found in the data; they have more time to reread the texts and enrich them.

MICHELE BUONO - VOICE OVER.

Not only has no-one been sacked but a new professional figure has been introduced at Associated Press: automation editor, part journalist and part software expert. Meanwhile in Durham, North Carolina, they are working hard and hiring more employees because now everyone wants this system. Not just news publications but also companies that produce reports of all types, because if they produce lots they can personalise them and generate them more quickly.

ADAM SMITH – CHIEF REVENUE OFFICER AUTOMATED INSIGHTS

Instead of telling one story and hoping that ten million people will read it, we give our customers the chance to tell ten million different stories in the certainty that everyone will read it because it is written specifically with them in mind.

MICHELE BUONO VOICE OVER.

The strengthening of the public university has also given new life to the construction sector: old sites have been redeveloped and, more importantly, it has been expanded outside of North Carolina, joining a federal network of businesses and research centres with the aim of facilitating the transfer of technologies to businesses. Washington, Smart Manufacturing Leadership Coalition.

DENISE SWINK - CEO SMART MANUFACTURING LEADERSHIP COALITION

Our platform is an online archive that everyone can contribute to, inserting ideas or data, and this allows us to help businesses choose the most suitable services for modernising.

JIM WETZEL – TECHNICAL DIRECTOR GENERAL MILLS

To make our distribution chain smart it would have taken ten million dollars and two years of work. Thanks to Smart Manufacturing we were able to adopt other solutions: we will spend just one million and it will be a little job of a couple of months.

DENISE SWINK - CEO SMART MANUFACTURING LEADERSHIP COALITION

We helped Praxair install infrared video cameras in a 900° oven.

LARRY MEGAN - R&D DIRECTOR PRAXAIR

The production of synthesis gas takes place at high temperatures and being able to see inside the ovens and understand what's going on is crucial for redesigning and improving processes.

DENISE SWINK - CEO SMART MANUFACTURING LEADERSHIP COALITION

For businesses it is money, for the country it is an advantage: it means more productive manufacturing and lower greenhouse gas emissions.

MICHELE BUONO VOICE OVER.

They have also helped pharmaceutical giant Pfizer in the preparation of modules that make it possible to produce medicines where they are needed, thus avoiding the need to send them, perhaps where there is a medical emergency.

ALTON JOHNSON – VICE PRESIDENT GLOBAL TECHNOLOGY SERVICES PFIZER

We monitor the entire process online. You can be in the US or Italy, and develop the product in Vietnam.

MICHELE BUONO VOICE OVER.

They take up 70% less space than a traditional plant and are operative in 2-3 weeks. Once upon a time it took 2-3 years.

KEVIN NEPVEUX – VICE PRESIDENT TECHNICAL SERVICES PFIZER

I have worked for Pfizer for 34 years and this is one of the most important technological advances I have ever witnessed.

MICHELE BUONO VOICE OVER.

In the end it is new technologies that are making it possible to take production back to the US precisely because manufacturing will become less expensive.

HAL SIRKIN - BOSTON CONSULTING

Most people were convinced that manufacturing in China was more economical and would always be so. In reality this wasn't the case because delocalisation has reduced the value of salaries and, in the end, there was a negative effect on our economy.

MILENA GABANELLI IN STUDIO

Also because they also want decent salaries now in China. The effect of

delocalisation was negative because when a company leaves, bars leave, cleaning companies leave, research leaves and everyone is driven away. From what we have seen with the new ultra-technological model it is no longer worthwhile manufacturing where it costs less. Now, is all this innovation missing in Italy? No. Imagine if around everything we will now see, and which is only a small part of all the research that takes place in Italy, there was suitable organisation to transform it into business. Beginning with healthcare, where technologies are being developed that will even be able to take doctors inside the bodies of their patients.

MICHELE BUONO VOICE OVER.

Italian Technology Institute, Milan laboratory.

GUGLIELMO LANZANI – ITALIAN TECHNOLOGY INSTITUTE

On this capsule we have printed electronic circuits produced with alternative materials to silicon, which are completely digestible.

MICHELE BUONO

What does that mean? In practice?

GUGLIELMO LANZANI – ITALIAN TECHNOLOGY INSTITUTE

We are sending devices into the human body with electronics that can carry out different functions, for example diagnostics. It is like taking the doctor inside the patient's body so they can take a close look at what is going on.

MICHELE BUONO VOICE OVER.

The circuits to insert in the capsules are printed in this lab. We envisage their industrial development.

GUGLIELMO LANZANI – ITALIAN TECHNOLOGY INSTITUTE

This could become a little production line, for example a start-up that then develops these products. Production could be distributed to small factories, where it is required, no longer mass production.

MICHELE BUONO VOICE OVER.

In the capsule there is a sensor that is able to make a diagnosis and send signals directly to a doctor's mobile phone. When fully operational the system will completely revolutionise hospitals. Pisa, Enrico Piaggio Institute.

MATTEO BIANCHI – INTERDEPARTMENTAL RESEARCH CENTRE “E. PIAGGIO” UNIVERSITY PISA

The idea is that of testing the return of tactile sensations in teleoperation so that the operator is able to control the action of the remote arm and, at the same time, feel what the arm is feeling.

MICHELE BUONO VOICE OVER.

This means that a surgeon can operate remotely and can also feel as if he is touching the patient, even if he is thousands of miles away.

EDOARDO BATTAGLIA – INTERDEPARTMENTAL RESEARCH CENTRE “E.PIAGGIO” UNIVERSITY PISA

These sensors can be worn on the fingertips and are able to restore some of the force that is applied to the finger when handling objects.

MICHELE BUONO VOICE OVER.

While robots may assist patients during the rehabilitation process. It isn't necessary that they all go into hospital, a webcam and an internet connection is all that is required.

SIMONE UNGARO – ITALIAN TECHNOLOGY INSTITUTE

Less time and less supervision of the course of treatment and this will mean that we can perhaps do more things and treat patients simultaneously with lower costs for the national health service for public treatment and lower payments by citizens in the case of private sector treatment.

ALBERTO DIASPRO – ITALIAN TECHNOLOGY INSTITUTE

Here microscopy is studied at molecular level, in other words the investigations that enable us to see how molecules act in living people. Whether the living person is healthy or unwell.

MICHELE BUONO VOICE OVER.

A ray of light instead of the scalpel in order to avoid biopsies.

ALBERTO DIASPRO – ITALIAN TECHNOLOGY INSTITUTE

So the technological development that takes place on this table is a technological development which will be compacted down into objects that are smaller than a toaster.

MICHELE BUONO

Will it all be more economical?

ALBERTO DIASPRO – ITALIAN TECHNOLOGY INSTITUTE

A super microscope today could cost around a million euro, tomorrow it could cost, and already does cost, 20,000 or 25,000 euro. This is the first system completely developed in Italy in terms of both software and hardware.

MICHELE BUONO VOICE OVER.

Like liquid graphene, obtained from carbon with a technique developed at the Italian Technology Institute.

VITTORIO PELLEGRINI - ITALIAN TECHNOLOGY INSTITUTE

Graphene marks the start of a revolution because graphene can be introduced into all of these materials to give them properties that they do not have.

MICHELE BUONO VOICE OVER.

It makes them smart, as the products of industry 4.0 will be, able to communicate and interact with the people that made them thanks to the possibility of producing foldable circuit boards.

ANDREA CAPASSO - ITALIAN TECHNOLOGY INSTITUTE

And also wearable. If you have a flexible support you can also have electronics integrated in your clothes, for example to monitor your heartbeat and blood

pressure. Many applications can be invented on a flexible support that isn't limited to the traditional silicon single chip.

VITTORIO PELLEGRINI - ITALIAN TECHNOLOGY INSTITUTE

A whole array of possibilities opens up, a material that transforms, amplifies the properties of traditional materials, and a genuine industry can be founded on this revolution.

MICHELE BUONO VOICE OVER.

As with organic plastic, produced from vegetable scraps rather than petrochemicals.

ATHANASSIA ATHANASSIOU - ITALIAN TECHNOLOGY INSTITUTE

It can be any kind of waste, we are using waste coffee from bars, cocoa, chocolate waste, rice, tomato, cinnamon, parsley, oregano waste; the plastic that comes from petrochemicals is not biodegradable but this kind of plastic is completely biodegradable.

ROBERTO CINGOLANI - SCIENTIFIC DIRECTOR, ITALIAN TECHNOLOGY INSTITUTE

I believe that the European food industry produces several tens of millions of tonnes of vegetable waste every year. Bring it together at a recovery station and from there produce plastic which can then be extruded and used in place of petrochemical plastic. Long-term planning is obviously necessary.

MICHELE BUONO VOICE OVER.

Like the decision to produce these robots in bioplastic because humanoids are also manufactured at this centre. It is called iCub and it is learning how to write, to move and to understand the world.

ALESSANDRO RONCONE - ITALIAN TECHNOLOGY INSTITUTE

Where is the lettuce?

I CUB

I don't see any lettuce. Correct?

ALESSANDRO RONCONE - ITALIAN TECHNOLOGY INSTITUTE

No, it is here.

I CUB

Ah here it is!

GIORGIO METTA - ITALIAN TECHNOLOGY INSTITUTE

Year after year we expect to see it move more autonomously, firstly in the lab but later also in factories and homes. In factories it helps staff or workers to finish their tasks with less effort.

ROBERTO CINGOLANI - SCIENTIFIC DIRECTOR, ITALIAN TECHNOLOGY INSTITUTE

There will be new jobs, as is always the case when there is a new technology. Let's say that the robot's educator is, for me, certainly the person that will develop all of the basic knowledge for a machine that is able to learn, as well as the programmer and the hardware engineer.

ALESSANDRO RONCONE - ITALIAN TECHNOLOGY INSTITUTE

Where is the lettuce?

I CUB

I believe that this is the lettuce, am I right?

MICHELE BUONO

What if it was a case of teaching a school of robots? Having a class of robots that learn?

ALESSANDRO RONCONE - ITALIAN TECHNOLOGY INSTITUTE

It would be a strange job but wouldn't be bad.

MICHELE BUONO VOICE OVER.

Because what you teach your robot will be learned, at the same time, by the global community of all robots like him. Intelligence won't be in individual heads but in a virtual cloud.

ROBERTO CINGOLANI - SCIENTIFIC DIRECTOR, ITALIAN TECHNOLOGY INSTITUTE

And they are like super mobile phones that are wirelessly connected, extremely quickly, faster than mobile phones, to this cloud. For this they are able to interact with you, you point something out to them, you get them to fetch it, you get them to carry out specific actions and if they don't know how, because it isn't in their head, they connect to the cloud and put it into practice.

GIORGIO METTA - ITALIAN TECHNOLOGY INSTITUTE

A robot that learns how to walk here will perhaps enable a robot in Japan to walk.

FRANCESCA NEGRELLO - ITALIAN TECHNOLOGY INSTITUTE

In a year we have managed to develop this prototype and it could potentially be reproduced perhaps on a slightly larger scale, the idea is to create a team that follows its development.

MICHELE BUONO VOICE OVER.

And industrial production could take place in Italy. This is Walkman and he gets people out of trouble.

LUCA MURATORE - ITALIAN TECHNOLOGY INSTITUTE

Let's say that it was designed to manage any type of disaster situation, not just in the industrial sphere where actions are planned in advance and predefined.

MICHELE BUONO VOICE OVER.

It can drive a car and arrive, for example, at the scene of a nuclear disaster and make it safe so people don't have to. Animaloids are used in earthquake and landslide areas because it is easier to move on four legs in these situations.

MICHELE FOCCHI - ITALIAN TECHNOLOGY INSTITUTE

If I have a video camera that gives me visual feedback so I can see what the robot is doing, I can command it remotely even from the other side of the world.

MICHELE BUONO VOICE OVER.

University of Pisa, Enrico Piaggio centre. Industrial robots are dangerous and are kept in cordoned off areas. Here they are studying in order to place them alongside workers and get them to work together.

ANTONIO BICCHI – INTERDEPARTMENTAL RESEARCH CENTRE “E. PIAGGIO” UNIVERSITY PISA

Passing him the pieces, holding heavier parts, for example, on an assembly line so the human operator can focus on the more interesting, creative, important and crucial aspects of the task.

MICHELE BUONO VOICE OVER.

Making it possible to increase the quality of work and productivity. How can these technologies be transferred to the industrial sphere?

ANTONIO BICCHI – INTERDEPARTMENTAL RESEARCH CENTRE “E.PIAGGIO” UNIVERSITY PISA

The system for transferring the results to industry doesn't work, it doesn't work at all. Everyone is probably to blame, industry on one hand, research on the other, we aren't always willing or able to devote time, energy and resources, and above all those who manage political and organisational aspects I'd say.

MILENA GABANELLI IN STUDIO

The US Department of Defence has also shown an interest in testing these humanoids in complex situations. Can they be used to fight? It could be highly tempting, even if they weren't designed for this reason. Their similarity to humans is quite remarkable, but as they have to carry out human functions it couldn't be any other way. Certainly it is the start of a scenario in which there are many questions. Could the amount of information we store in robots enable them to develop a conscience? In the future will a machine with eyes change nappies and attend to the elderly in place of babysitters and nurses? The impact of robotics can already be seen in all sectors of society, beginning with industrial automation, autopilots, gardening and domestic functions, from the exoskeletons used to help those that have lost their mobility or a limb through to its usage in hostile environments. This gives an idea of its potential and therefore also its future markets. Now, we are among the world's leaders in the programming of this technology and artificial intelligence. We don't need to organise conferences to stay on top; we need intermediate structures and we need to be able to offer guarantees to investors: broadband, streamlined bureaucracy and an efficient legal system. In short: capable people in the key places. Beginning with schools.

MICHELE BUONO VOICE OVER.

At Galileo Galilei school in Trento they have carried out an experiment and asked themselves: if in the field of research all centres are connected and work together, why don't we do the same thing at school? Robotics laboratory; older children together with younger children. And these are the results.

CHILD

It is nice to build something and then see it move and do everything you tell it to do.

CHILD

If there isn't any work for the old work it will help to programme the robots.

FRANCA SCARPA – COMPUTER SCIENCE TEACHER GALILEO GALILEI SCHOOL - TRENTO

Teaching is changing completely.

MICHELE BUONO

In what way?

FRANCA SCARPA – COMPUTER SCIENCE TEACHER GALILEO GALILEI SCHOOL - TRENTO

Because we have lessons in the lab. Children are given tools but not the end product, they are taught broad skills. Some are better at programming, others are better at electronics, and so everybody finds their own space.

STUDENT

We use our eyes to see and understand everything immediately. We have to teach robots what it means when there is a black pixel near a white pixel at a very basic level because robots are not intelligent and so we have to teach them.

ANDREA CRISTOFORI – PHYSICS TECHNICIAN GALILEO GALILEI SCHOOL - TRENTO

But this doesn't mean that you impose your knowledge, you have to build it with them, you have to start together and gradually grow.

MICHELE BUONO VOICE OVER.

The idea is that of constructing a prototype robot, on a reduced scale, to rescue disaster victims.

STUDENT

So it can potentially be used, for example, by the emergency services, to protect the public or even by the police to find and defuse bombs, things like that.

CHILDREN TAKING PHOTOS

A good idea to copy.

FLAVIO DALVIT – HEADMASTER GALILEO GALILEI SCHOOL - TRENTO

Their smartphones are a third hand that helps them get around in the outside world. Take advantage of all the devices that technology makes available, don't be slaves to them, it is you that must manage them.

MICHELE BUONO VOICE OVER.

There is a robotics championship in China where the best in the world do battle; the pupils of Galilei beat all the other Italian schools but the school can't afford the journey. The children don't give up though and they find the sponsors themselves.

STUDENT

We invited them all to a press conference, we launched an online fundraising campaign, a crowdfunding venture in which anyone that believes in the project, even individuals, can make a small contribution.

STUDENT

We achieved the planned budget, around 20,000 euro, and we set off for China.

ANDREA CRISTOFORI – PHYSICS TECHNICIAN GALILEO GALILEI SCHOOL -TRENTO

It is very exciting, you start from nothing, because we started with nothing, and then you see your robots being put together with a screwdriver, piece by piece, and you end up at the world championships. You end up competing against the best in the world.

STUDENT

These are the last minute alterations being made by the superteam.

ANDREA CRISTOFORI – PHYSICS TECHNICIAN GALILEO GALILEI SCHOOL -TRENTO

The best round of the entire world championships is ours, 471 points, a masterpiece. It is the perfect match, one you dream about your whole working life, so it is obviously very exciting. It is also lovely for me because, let's not pretend, I like it, I enjoy it, so it is also nice for me; the third thing is that you see that the school is changing, you see that with commitment, with honesty and the right kind of work, you are finally making things change, and what could be better than that?

MILENA GABANELLI IN STUDIO

They later came third in the world robotics championships and there are many schools that have a modern vision, where the teachers don't say "we have always done things like this at school". The problem is that these schools operate independently of each other, but the process has begun and everyone must play their part if we are to seize this opportunity.