BRIEFING
STOA Options Brief

European Parliament

Analysis exploring risks and opportunities linked to the use of collaborative industrial robots in Europe

In recent years, 'collaborative robots' or 'cobots' that allow human-robot interaction – even with physical contact – have burst onto the scene. The EU has led the development of collaborative robotics and the growth of this technology has been spectacular. This study analyses the current state of collaborative robotics by exploring the risks and opportunities of this technology and possible options for harnessing the benefits and tackling the risks associated with the increasing deployment of these technologies in EU industry.

Impacts and outcomes

A new Panel for the Future of Science and Technology (STOA) study analyses the possible impacts and outcomes of using robots and collaborative industrial robots in Europe and proposes fundamental policy options based on an analysis of the risks and opportunities of the technology.

Impacts on job creation

The main objective of collaborative robotics technology is to complement human abilities to solve complex problems in imprecise tasks with the precision, power, and endurance characteristics that robots possess. Cobots do not replace humans therefore, but provide them with assistance by improving their working conditions and relieving them of arduous and tedious tasks. Under this approach, collaborative robotics technology does not have a significant impact in the manufacturing industry but implies an advantage in the technological sector, creating new jobs and contributing to retaining existing ones. Additionally, this technology can help the survival of small and medium-sized enterprises (SMEs) in the production sector by providing them with access to automation technologies that traditional industrial robotics cannot provide due to the cost and difficulty of producing small and medium-sized product batches. Unfortunately, cobots are still used in many cases with little or no interaction with workers, which largely equals their impact to that of traditional robotics. **The results obtained in interviews and surveys clearly show that most experts agree that this technology contributes to the creation and retention of jobs**.

Impacts on safety and working conditions

The main characteristic of collaborative robotics is its inherent safety. In its initial conception, the aim has always been to enable direct human-robot interaction by improving working conditions and seeking to significantly improve ergonomics. However, although cobots allow for easier risk analysis and avoid having to put them inside a protective cage, they are not yet completely safe for human-robot interaction and more advanced sensor capacities are needed. There are many possibilities to reduce risks, but these often restrict cobots' capabilities. For several stakeholders, collaborative robotics can also expose human operators to additional stress. **In general, experts agree that collaborative robotics also implies improved manufacturing sector safety and a clear improvement in working conditions**. Experts also agree that collaborative robots are more easily accepted by workers than traditional industrial robots.

Economic, social, and environmental impacts

Supported by lower acquisition, installation and usage costs and a higher capacity for reallocation and adaptability to frequent task changes, **collaborative robotics improve manufacturing sector productivity and, in the case of SMEs in particular, they increase their competitiveness and reduce production costs**. The EU's leading position therefore gives it a competitive advantage with a significant economic impact. Most experts point out industry still lacks knowledge on collaborative robotics, which limits their possible economic impact. The growth of the collaborative robotics market will continue to outstrip that of the industrial robot market. However, there is a risk that the EU loses its leadership in this sector and is surpassed by the Asia-Pacific region in the coming years. Experts assure that there is no major problem of social acceptability of collaborative robots. The possibility of directly interacting with robots opens up a vast world of opportunities for service robotics in fields such as care robotics, the health sector, or the construction sector. However, **current EU legislation limits development** compared to other countries such as the USA and China. Several authors remark that collaborative robotics can contribute to improving resource efficiency and can also act as enabler of remanufacturing and circular economy. Cobots are lighter and smaller than traditional industrial robots and, therefore, consume less energy. However, **experts do not see this technology significantly reducing the manufacturing sector's carbon footprint.**

Ethical impacts

Ethical considerations apply to robotics in general, but especially to collaborative robotics involving the inclusion of humans working together with machines. As noted, there is no problem of worker acceptability, and cobots present a more favourable image to society than traditional robots, as they claim to avoid replacing humans with a machine. However, a lot of work remains to be done and aspects such as reducing the possible mental stress that these robots can cause to workers and ensuring operator privacy should be considered in future applications of this technology. Collaborative robotics can also mean progress in the **incorporation of people with physical or mental disabilities into the world of work**. Likewise, it can help integration in general by eliminating limitations of strength or height in certain tasks.

Knowledge management impacts

As an integral part of the robotics world in general, collaborative robotics has also contributed to the development of open-source software, making many development tools available to the robotics community. This contribution is likely to increase significantly in the future, reducing duplication of work and enabling faster technological progress. The same applies to the publication of scientific results in open-access journals. Nevertheless, **companies must maintain their leadership by adequately protecting their competitive advantage through patents**. This is a key factor for European companies that have taken the lead in this technology.

Policy-options

The policy options have been grouped into legislative and standard policies, economic policies, social and environmental policies, and ethical and gender policies.

Legislative and standards policies

Policy option 1: Existing regulations do not clearly support the development of collaborative robotics technology. **Human-robot interaction conditions and safety assessments need to be facilitated by developing clearer regulations that do not limit the development of collaborative robots and respect workers' health and wellbeing**

A revision of the EU Machine Directive could provide a simpler definition of all aspects related to the use of collaborative robots and help to reduce and simplify the incorporation of this technology in the industry sector and society through the use of collaborative service robots. Existing regulations and standards are still difficult to implement for EU companies. It is obvious that the EU is characterised by a higher degree of protection for its citizens ensuring their safety and the quality of their working conditions. However, more permissive regulations in other countries can give their companies a competitive advantage in the development of technology. It is important to reach a compromise that allows competition on a level playing field while guaranteeing people's safety and wellbeing through agile and efficient regulation allowing for swift adaptation to technological developments. Most experts consulted agree that the current legislation and standards are still not completely developed.

Economic policies

Policy option 2: The EU is currently leading the world in the introduction of collaborative robotics technology. Support for this technology in Europe could contribute to an economic benefit in one of the key sectors for technological developments in the coming years. **The EU should maintain or even increase the budget for research activities where human-robot interaction or collaborative robotics are relevant.**

Collaborative robotic technology is considered one of the 12 potentially economically disruptive technologies that will transform life, business, and the global economy. To maintain or increase their leadership position, matching that of US companies, financial support should be provided for research into aspects related to collaborative robotics, as well as support for the technological development of European companies in this sector. Incorporation of cobots into major robot manufacturers' product ranges has been remarkable in recent years, and the growth of the market and prospects predict a remarkable evolution in the coming years. Collaborative robotics is a key element of Industry 4.0 and can enable leadership in the production sector by increasing productivity and reducing costs, while at the same time improving working conditions. Additionally, collaborative robots can represent an important advance in service robotics in key sectors for a Europe that has an ageing population. Collaborative robotics still has many limitations that prevent achievement of all the possible benefits of this technology. Due to the necessary safety conditions, collaborative robots cannot be as fast or exert as much force or load capacity as traditional industrial robots. Advances in technologies such as proximity detection systems or projection-based monitoring systems to slow or stop robot movement when the system detects the presence of a human, or the development of variable stiffness actuators that reduce possible physical damage, needs to be explored in more depth to allow cobot features, their productivity, and the number of possible applications to be increased.

Social and environmental policies

Policy option 3: Collaborative robotics and the development of applications requiring human-robot interaction could bring important societal benefits**. There is a need to encourage the development of policies to support the creation of new real-world applications using high levels of interaction by promoting training of all actors in this technology.**

Although the growth of collaborative robotics has been spectacular in recent years and the forecasts are very good, in many cases cobots are still used with a low level of human-robot interaction, without really taking advantage of their collaborative characteristics. This limits the benefits of this technology and its positive impacts. The problem often derives from the need to conceive collaborative tasks from a new perspective that includes the concept of real human-robot interaction at a high level from their design stage. It is therefore necessary to promote training of the main productive sector actors in this technology to increase knowledge of the characteristics and advantages of collaboration between humans and robots and to support research in the creation of new productive methods that contemplate this possibility from the design stage. Additionally, it would be convenient to develop

policies that allow the adequate training of workers in the use of collaborative robotics, increasing worker acceptance and minimising the possible risks of interaction between humans.

Ethical and gender policies

Policy option 4: Collaborative robotics can also mean the elimination of barriers that prevent less physically gifted people from accessing the world of work. **However, there is a need for policies that promote ethical assessments to ensure safe human-robot collaboration, worker acceptance and privacy.**

The benefits of reducing or even eliminating physical barriers that make it difficult for certain people to enter the world of work due to physical or mental effort or physical conditions are clear. However, the incorporation of humans into the control loop of robotic systems involves the need to carry out more in-depth ethical evaluations than are necessary in traditional robotics. It is not only necessary to carry out assessments regarding the physical safety of the operator in collaboration with the cobot, but other aspects such as the possible mental stress that may be caused to the user also need to be taken into account. Ergonomic aspects also play a fundamental role in the evaluation of the task. It may also be necessary to acquire information about the operator during the execution of automated tasks, which necessarily requires the need to ensure user privacy. It is also necessary to ensure worker acceptance of collaborative robotic systems. Therefore, ethics committees must carry out in-depth assessments that take all the aspects that real collaboration entails into account – even with physical contact between humans and robots. Again, training ethics committees in these new technologies could play a fundamental role in ensuring the ethical aspects of collaboration between humans and robots.

This document is based on the STOA study 'Analysis exploring risks and opportunities linked to the use of collaborative industrial robots in Europe'. The study was written by Ernesto Gambao (Universidad Politécnica de Madrid/UPM) at the request of the Panel for the Future of Science and Technology (STOA) and managed by the Scientific Foresight Unit, within the Directorate-General for Parliamentary Research Services (EPRS) of the Secretariat of the European Parliament. STOA administrator responsible: Andrés García Higuera.

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