About the Interview

The tacit knowledge involved in the defence sector makes it difficult to simply convert civilian facilities and personnel into assets of the defence sector. States need to be strongly engaged in defence-related R&D. We should have a more sober and fact-based discussion about autonomous weapons systems. Autonomous or semi-autonomous weapons have been operational for a long time. While these weapons systems come with risk, human error remains one of the greatest risk factors in war.

About the interviewee

Prof. Dr. Mauro Gilli is Professor of Military Strategy and Technology at the Hertie School. His research focuses on military-technological competition, strategic rivalry, and modern operations, with work published in journals like International Security. He previously served as a Senior Researcher at ETH Zurich (2016–2025). Gilli holds a PhD from Northwestern University and an MA from Johns Hopkins SAIS. He is a recipient of the Best Academic Article Award from the America in the World Consortium.

About the Interviewers

Xerxes Hafezi Rachti is currently enrolled at the Hertie School, studying International Affairs with a focus on International Security. At the University of Mannheim, he attained a multidisciplinary bachelor's degree in English and American Studies and Business. His research focuses on technological innovation, strategic competition, and military operations.

Jolina-Zoe Zarda is a Master's student in International Affairs at the Hertie School, Berlin, specialising in international security. She holds a BA in International Relations and International Organisations from the University of Groningen. Her interests include security and defence, peacekeeping, and non-state actors. She has experience with the Friedrich-Ebert-Stiftung in Athens and is active in the Hertie Security Student Club and the German Council on Foreign Relations.

Jolina-Zoe Zarda:

Welcome to this brief interview on the broader issue of the defence industrial complex. We may start by discussing the possible integration of the civilian and defence sectors. Politicians often claim that Europe's industrial capabilities can easily be repurposed for defence needs. How realistic are calls to repurpose existing manufacturing capabilities from other sectors to serve the manufacturing of military equipment, such as tanks and ammunition, in your view, and why?

Prof. Dr. Mauro Gilli:

Thank you. Generally, certain parts of a country's industrial base can be utilised in the defence sector. However, it is important to emphasise that this is a broad observation with several important limitations. There are components, subcomponents, and parts that, in some areas, overlap and create synergies between the industrial, commercial, and defence sectors. For example, some commercial screws, fasteners, and bolts can be used, depending on the context, also in the defence sector. However, as the performance of a given system increases, and operational or environmental conditions in which it operates become more demanding (e.g., speed, depth, etc.), such opportunities for synergies shrink significantly. This is even more so for defence-specific treatments, parts, subsystems, and systems – e.g., chromium plating for cannon barrels, artillery shells and munitions, defence electronics, and propulsion systems, etc. This does not imply that synergies between the commercial and military industries do not exist; rather, it points to difficulties for the following reasons. First, consider the materials themselves. In the defence industry, materials need to meet specific technical requirements (e.g., in terms of mechanical strength, thermal fatigue, fracture toughness, and others), and often defence companies need very special alloys that do not have application in the commercial sector. Access to the required raw materials – including metals like antimony, titanium, tungsten, and others – with extensive applications in defence but much more limited ones in commercial use – must be secured. Secondly, these alloys and metals need to go through high-precision machining. But since the material properties of these alloys and metals differ from those in the commercial sector, and since the technical specifications they have to meet are much higher than those in civilian applications, specialised machine tools are necessary. To put it bluntly, the tools needed to cut antimony, tungsten, or titanium are utterly different from those used for light aluminium. Similarly, the specialised workers, particularly those forging, machining or welding the metals mentioned above, possess skills and know processes that are completely different from those in the commercial sector. This means that while you can retrain these individuals, it takes time. Ultimately, having an industrial base can be helpful, but it is far from enough to boost defence production, since you need very specific skills, capabilities, and machinery at all levels. This becomes even more evident when dealing with explosives and munitions. Storing explosives is entirely different from storing tyres, so when setting up a production plant for artillery, the production plant must be organised around the need to

ensure safety and to comply with governmental regulations about handling explosive materials. These are requirements and regulations the car industry does not need to meet.

Jolina-Zoe Zarda:

Thank you, it seems like there is a lot of work to be done. What role does the state play in defence R&D, and what importance do you ascribe to it?

Prof. Dr. Mauro Gilli:

The role of the state is essential, primarily because the defence industry needs to supply goods that are difficult to value by the market. The importance of the defence industry appears clear now that the stock market valuations of defence firms have risen markedly because people recognise this need. But this was not the case ten years ago or even five years ago. This means that markets do not anticipate these needs quickly enough and have a much shorter time horizon than the one required for defence investment. Therefore, consistent funding for these companies is essential because the moment you need to increase production, it is too late. Defence capabilities must be sustained continuously, which highlights the difference between the goals of commercial and defence technologies. Commercial technologies are tailored to customer tastes and preferences, often with price in mind. Price is not the deciding factor for all goods, but it plays a significant role in most. However, this is not true for weapon systems. They need to perform effectively on the battlefield, so price is less critical.Since price is less critical and these systems are valued for meeting specific battlefield performance requirements and other operational or strategic objectives, markets may not be the most effective method to determine which R&D to pursue. I'm not referring to efficiency, but effectiveness. Therefore, states are vital to sustained and well-directed defence R&D.

Xerxes Hafezi Rachti:

Staying on this topic, we would like to hear your opinion on defence sector cooperation. How can we tackle current cooperation problems, for example, with FCAS?

Prof. Dr. Mauro Gilli:

Well, these are inherently difficult to address because, at the end of the day, defence is a prerogative of the states. Each state has its own specific incentives and interests, which often do not align with European interests and incentives. Cooperation in the defence industry is unusual because, for many actors involved, primarily the companies and the national governments hosting these defence companies, cooperation is not convenient, whether in terms of revenues or political considerations, namely, employment. In the end, cooperation entails consolidation, and consolidation means firing workers and closing production plants. Therefore, national governments are often reluctant to closer cooperation in defence, as they do not want to lose jobs, which is often a primary consideration. Cooperation is generally perceived as good because the word has a positive connotation, but many tend to ignore the downsides. Related to this, there is a wider problem in Europe: for at least the past 30 years, many have been fixated on increasing defence cooperation across the continent. The idea of a more integrated defence industry sounds promising, but the often-overlooked problem is that cooperation is a means, not a goal. Possibly more problematic, innovation has received considerably less attention than cooperation.

Xerxes Hafezi Rachti:

More specifically, should the EU permit mergers to create fewer but larger industrial champions, or do you believe that a greater diversity of smaller companies is more efficient?

Prof. Dr. Mauro Gilli:

The European Union not only permits but also actively encourages member states to promote mergers and acquisitions. The main point is that many nations have resisted this push and decided to halt mergers between countries. There are clear advantages to mergers. A Bruegel study from a few months ago found that the unit price of armoured vehicles is significantly higher due to fragmented production in Europe. This makes sense because lower production volumes lead to reduced output, which

increases the fixed cost per unit, resulting in much higher prices. This is expected; thus, we should promote mergers, but it is also important to remember that this is not a complete solution to all of Europe's issues. Maintaining some diversity could offer strategic benefits. Having multiple types of weapon systems that Russia must contend with is actually advantageous. There is more than one correct approach to this issue. I want to emphasise that there should be a broader discussion considering multiple trade-offs.

Jolina-Zoe Zarda:

Now, we would like to shift to quasi-autonomous weapon systems. What is your perspective on the implementation of these systems, like drones that are used in swarms or kill zones where hostile forces are automatically engaged?

Prof. Dr. Mauro Gilli:

First, over the past 10 years, there's been a debate that I found was a bit curious, with many people calling for these systems to be banned because, according to this emerging view, autonomous systems would represent a serious threat to humanity. The truth is, many autonomous or semi-autonomous systems have been operational for a long time, and many people did not realise. American ships are equipped with the so-called Phalanx CIWS automatic cannon. The idea is that because enemy missiles can fly low and skim the waterline at sea, the available reaction time to an incoming missile would not be sufficient for a human being to engage the threat. This automatic cannon engages as soon as something approaching the ship meets some specific parameters (e.g., speed, direction and others). Similarly, anti-radiation missiles have been used since 1982. This autonomous system detects the target, identifies it, and then strikes. These systems have existed for some time, and with technological progress, it is now possible to further enhance their applicability. Of course, autonomous systems raise some concerns, but generally, we also know that in war, many accidents occur due to human error. The conventional view is that there should be a human in the loop to prevent accidents and problems. While this is true, we must also remember that humans are often the source of error, so this is not a complete solution. There are debates that delve into sci-fi and dystopian fiction, but I think it is not worth to have a much more sober and fact-based discussion.

Jolina-Zoe Zarda:

If these systems possess advanced capabilities today, do you think it is a necessity for Europe to invest in such systems to offset disadvantages in manpower, or do you consider the technical risks as too high?

Prof. Dr. Mauro Gilli:

Sure, yes—but it's important to remember that we still require military personnel. For example, the challenges Ukraine faces in the Donbas stem from a shortage of manpower. No matter how advanced the systems are, they cannot fully replace personnel. Autonomous systems can help, but it should not exempt us from considering how to meet the demands for military personnel in Europe.

Xerxes Hafezi Rachti:

Now, onto our last aspect, the Russian defence industry. To you, are there any obvious steps the EU has missed in their efforts to reduce the capabilities of the Russian defence industry? More specifically, given how sanctions are implemented, is there potential to reduce Russia's capabilities?

Prof. Dr. Mauro Gilli:

Russia has managed to circumvent sanctions, and this could be addressed by simply looking at the exports of some specific European companies. Robin Brooks shows on Twitter how exports to Central Asian countries like Kazakhstan and Kyrgyzstan by European countries like Italy, Germany, and France have skyrocketed since the invasion of Ukraine. Such a sudden increase in demand by these countries leaves little doubt about what is going on: some fictional companies in these countries buy goods previously purchased by Russian companies, and of course, these goods never reach the intended address, and stop somewhere else in Russia while in transit. These exports could be prevented. The second critical aspect is

machine tools. There is a report by Rhodus on how Russia manufactures its missiles. It's fascinating, and it shows that Russia requires high-precision machine tools from European countries, specifically Southern Germany, Switzerland, Northern Italy, and some from the Czech Republic, possibly supplemented by South Korea. Without those high-precision machine tools, the Russian missile industry cannot survive. China cannot help in this instance because it has not yet produced such high-precision machine tools. Therefore, European countries could address this issue very quickly. We approach these companies and ask them what their next orders to any of these Central Asian countries are and at what price, and we, Europeans, buy these machines. The company doesn't lose anything; we keep the production going, which is very important for this industry, and for European countries, it's a minimal cost with significant effects.

Xerxes Hafezi Rachti:

Thank you for taking the time to participate in this interview today.

Prof. Dr. Mauro Gilli:

My pleasure, these are very important topics and your questions focused on some of the most critical aspects. Thank you.

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