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Digitalization of the German and European Economy: A Call for Action

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Summary

The progress of digitalization in the economy and society is the dominant issue in current discussions about innovation policy – and rightly so. The objective of this position paper is to summarize the fields of activity considered most important by Siemens and thereby contribute to the ongoing formulation of innovation policy in Germany and Europe. In the interest of brevity, we have refrained from presenting background information here. The individual positions can be summarized as follows:

- Given the rapid progress of digitalization, the tools of German and European innovation and funding policy require greater agility, an increased focus on market-oriented innovations and less complexity. R&D spending will have to expand to keep pace internationally; this must be anchored in a revised R&D intensity target of 3.5% of GDP. Germany and Europe can and should learn from innovative countries such as the United States and Korea.
- Holding a leading position in the development and mastery of trailblazing digital technologies remains a crucial necessity for achieving future economic success. It can be assumed – and confirmed by skills monitoring – that Germany and Europe lag behind in many digital technologies, especially behind the United States. This deficit must be overcome by making determined investments and taking action, for example, in support of increased entrepreneurial freedom for universities.

- Innovation is about more than just new technology. Increasingly, it manifests itself in new processes and business models. Particularly in the innovation of business models, Germany needs to catch up. A correspondingly broad interpretation of the term “innovation” should be applied in determining innovation policy.
- In addition to focusing on risk avoidance (for example, data protection, IT security), the legal framework also needs to significantly increase its focus on leveraging opportunities presented by digitalization. The Digital Single Market must be rapidly implemented so digital businesses in Europe can scale up just as rapidly as those in the United States or China. Excessive regulation in areas such as IT security and the use of data must be avoided, and the principle of contractual autonomy in the B2B sector must be strengthened.
- It is crucial that the discussion concerning digital infrastructure is not reduced to a deliberation about providing universal broadband connectivity. In the use of such infrastructure, the traditional user groups (end customers, retailers and so on) will increasingly be joined by geographically dispersed industrial applications (the Internet of Things) whose specific requirements must be taken into account much more than previously. Net neutrality must be upheld as a fundamental principle of internet usage, however, guaranteed service quality, for example, with respect to latency times, must be possible for industrial applications.
- Digital platforms and associated ecosystems are the most important factor in the design of a digital economy and society. Both commercial and noncommercial platforms can make considerable economic contributions. The latter may, however, only receive support when a market failure prevents development of a commercially operated platform. Excessive regulation of commercial platforms should be avoided; the existing legal framework must be fully exploited first.
- In supporting digitalization, the role of standards should be neither under- nor overrated. Policymakers can support the establishment of suitable standardization alliances to address systematic standardization issues (for example, smart grid and Industry 4.0). Even in the age of digitalization, however, standardization will generally remain a voluntary, industry-driven activity in which a balance has to be struck between cooperation and competition and over which politics should have no influence.
- To anchor digitalization in education and vocational training, digital technologies must be part of the mandatory curriculum at all levels of school, vocational and university education. In particular, education policy should focus on fighting the shortage of skilled workers in critical fields and increasing the attractiveness of MINT subjects. In addition, an immigration policy has to help in confronting the shortage of skilled workers.
- Besides supporting research projects and institutes, the public sector can and must make important contributions to the digitalization of the

economy and society in the area of procurement as well as in e-government while also acting as a role model for other parts of society.

- Digitalization of the German and European economies will not be possible without gaining public acceptance. Important conditions for this acceptance include a clear affirmation of digitalization's opportunities from all political parties and institutions, credible expression of a political will to use social policy to alleviate the risks associated with digitalization, and increased cooperation between management and labor-unions in companies.

1. Innovation funding and general conditions for innovation

In recent years, the research and development spending target of 3.0% of GDP was nearly but not fully reached. A more important issue than taking the last step to reach the three-percent mark is, however, a revision of the target to 3.5% to successfully address the shift from "traditional markets" (with low R&D intensity) to "digital markets" (with high R&D intensity) and to close the gap with comparable countries such as Japan and Korea.

Increase research and development spending to 3.5% of GDP.

Germany's ability to drive innovation ranks as good, if not very good, in international comparisons. That does not, however, necessarily mean that German and European innovation and funding policies are in tune with the times and prepared for the future. In an increasingly competitive international environment and against the backdrop of ever-shorter innovation cycles and the rapid digitalization of all aspects of economic and private life, it is no longer enough to question individual aspects of German and European innovation policy; its basic principles must also be called into question.

In particular, a comparison with other highly innovative countries (United States, Korea, Japan, and so forth) is imperative, given that innovation policy tools in those countries often differ considerably from those in Germany and Europe. Germany must be prepared to learn from the best and adopt successful concepts.

Learning from other highly innovative countries.

These are possible questions to address:

- Why does Germany continue to refrain from the use of tax incentives to promote research, instead relying only on state-organized aid programs with their long time horizons, even in an era when businesses contend with tighter and tighter schedules when developing new technologies and launching them on the market as innovations while innovation becomes increasingly difficult to plan?
- Why is support for businesses (except SMEs) limited to 50% in Germany and Europe, while countries such as the United States show much greater readiness to provide selected businesses up to 100% support for risky research projects?
- What can Germany learn from other countries to reshape its complex, compartmentalized support mechanisms to create a consistent innovation policy in which a manageable number of support programs emerges directly from a clearly formulated innovation strategy? How can greater transparency be achieved in the allocation of public funding? How can the number of accompanying committees, dialog platforms, and the like be reduced to a reasonable level?
- For digital innovations in particular, the boundaries between research and commercialization are becoming increasingly blurred. How can market-oriented R&D projects also profit from a funding policy?

Improving cooperation between universities and businesses.

The transfer of new technologies and findings from academic research to market commercialization is an important driver of innovation. Efforts to obligate universities to take a more commercially oriented approach to exploiting research results have proven counterproductive for cooperation between the business and science communities. Protracted discussions about exploitation rights for university research projects funded by businesses – an uncommon practice in the past, have noticeably complicated cooperation and knowledge transfer. Relations between universities and business are in need of recalibration.

Stronger start-up culture.

There is still too little to see of a start-up culture in Germany, a deficit in the county's innovation landscape that has long been criticized. There is an urgent need to eliminate such well-known barriers as the tax treatment of venture capital. In addition to the founding of start-ups, scaling them up also needs to be a focus of funding policy. It should also be noted that start-ups emerge not only through the entrepreneurial initiative of individuals: established companies are also increasingly founding start-ups as vehicles of innovation. These are also worthy of receiving support from start-up funding.

2. Mastering key technologies

A leading position in the development and mastery of trailblazing digital technologies remains a fundamental necessity for future economic success, and in digital technologies in particular – IT security, automated analysis of large quantities of data, machine learning, and other variations of artificial intelligence – there are many gaps in Germany's expertise, especially in comparison with the United States.

Using skills monitoring to identify gaps in digitalization skills.

In a first step, these gaps must be systematically identified and clarified in a structured process. With the proper focus, national skills monitoring as currently pursued by acatech (the National Academy of Science and Engineering), the BDI (Federation of German Industries), the BMBF (German Federal Ministry of Education and Research) and others, can be a suitable approach. In carrying this out, a consistent approach should be taken with support from all governmental agencies and stakeholders.

Increased flexibility for universities.

Once identified, skills gaps have to be closed by taking determined measures. Here the universities are also called on: Their freedom to quickly make significant and purposeful investments to establish new fields of research needs to be significantly expanded. This can mainly be achieved by higher and more reliable core funding and more decision-making autonomy. Such a strengthening of the universities' position would also considerably increase their attractiveness and accessibility to top foreign researchers.

Sovereignty through mastery of key skills.

Regulatory measures, such as those occasionally discussed within the context of digital sovereignty and intended to reduce dependence on foreign technology providers, are deleterious to Germany's export-based economy and are therefore to be avoided. True sovereignty can only be achieved through mastery of key digital skills.

3. Increased understanding of innovation

Expanding the definition of innovation.

New technologies are an important driver of innovations. However, for many innovations the technology is not the only ingredient. The capacity to drive innovation also includes the ability to create new products from existing elements, to reinvent processes, and to link services and sources of income to a new business model. Technological and nontechnological innovations often go hand in hand. For example, the car-sharing business model could only become reality thanks to Internet of Things technologies.

As a rule, innovation funding in Germany is linked to the development of a technology. This appears insufficiently ambitious, since it is precisely in nontechnological innovation that Germany does not appear to hold a leading

position. The United States, in particular, is much more at ease with translating new technologies into new and creative products with new business models, as demonstrated by such examples as AirBnB and Uber.

Like technological innovations, nontechnological innovations often involve high up-front investment and high risk. In addition, the success of such innovations is often difficult to assess. In the end, many businesses and institutions, regardless of their size, often demonstrate little willingness to rethink and reinvent established structures, processes and rules; additional incentives are needed.

For these reasons, a modern innovation policy must also address the question of how nontechnological innovations can be supported effectively. Limits are certain to be imposed on such support by the competitive nature of process or business model innovation, for example. Measures that contribute to raised awareness of the importance of nontechnological innovation are conceivable, however. Basically, a forward-looking innovation policy will have to draw from an ever-broader definition of innovation.

Besides their character (for example, technology, process, business model), innovations also differ in their objectives. As a rule, innovations pursue a commercial objective: By bringing to the market a new product that provides added value for customers willing to pay for it, suppliers not only create a benefit for society but increase their profits as well.

Nonacademic and noncommercial undertakings such as public agencies or charitable institutions can also increase their impact with innovations. Modern innovation policy should also encourage and promote this approach for innovations, which is often called social innovation. Conversely, modern social policy should recognize innovation as an important tool.

Innovation funding for public agencies or community institutions ...

... but no earmarking of innovation funds.

It is important, however, that innovation policy not allow itself to be subordinated to social policy goals or other goals. Innovation with noncommercial or social motivations is not, superior to commercially motivated innovation nor is it more worthy of support. What matters is the overall benefit to society.

4. Shaping the legal framework

Wherever possible, legislative bodies should work toward international harmonization of regulatory frameworks. When restrictive provisions of EU legislation are implemented, additional restrictions at the national level must be avoided. Flexibility in implementation at the national level should be exploited to the extent that EU legislation grants this in order to establish an innovation-friendly environment in Germany.

International harmonization of regulatory frameworks, implementation of the Digital Single Market.

The Digital Single Market must be implemented quickly. Data must be able to cross European borders unhindered and should not be subject to geographic restrictions within Europe's borders. Rules on data storage, data security and data protection must be the same throughout Europe to enable digital start-ups and others to rapidly scale up to European dimensions and to lessen the current disadvantage in scale with respect to start-ups in the U.S. market.

The use of data for innovative applications and business models must be anchored as a secondary goal of data regulation with only slightly lower priority than the primary goal of protecting personal privacy rights. The European General Data Protection Regulation must be implemented in national legislation without further restrictions. In applying the EU's General Data Protection Regulation, technical solutions for the protection of personal data, such as anonymization and pseudonymization, must be exploited to their full potential. A distinction between data with and without personal links is useful, so it is possible to more easily use the latter for innovative ideas. With industry's participation, the European Data Protection Board should soon issue guidelines that enable the use and analysis of data on a sound legal basis.

Innovative use of data as a secondary goal of data regulation.

Not every technical innovation requires immediate intervention by legislators. Wherever possible the principle of contractual autonomy should be strengthened, at least in the B2B sector. This makes it possible for the companies involved to determine contractual arrangements on a case-by-case basis for the implementation of innovative business models. Further considerations of statutory regulation of data trading, such as on the issue of data ownership, are currently not useful at either the national or the European levels.

Strengthening contractual autonomy instead of data ownership.

The increasing use of autonomous systems in various fields of application (for example, industrial robots, autonomous driving) is also not yet cause for short-term action. Parallel with ongoing technical developments, however, clarification is required on whether future refinement of the legal framework is useful in the following fields:

Preparing a suitable legal framework for autonomous systems.

- Attribution of an autonomous system's legal notifications to the system's operator
- Enactment of absolute liability for operators of autonomous systems analogous to Section 7 of Germany's Road Traffic Act (StVG)

- Behavior of autonomous systems in the event of unavoidable emergency situations and corresponding instructions by the programmer of the software controlling such systems

Regarding IT security, the recently adopted IT security law provides an adequate legal framework. IT security is very case-specific and does not lend itself to generalized regulatory provisions. It is crucial that businesses be supported and empowered in taking IT security into consideration in all phases of the development of products and systems ("security by design"). This is the only way to achieve sufficient security for all elements of a system (components, communication, software, and the like) and the focus should not only be on technologies but also on processes and methods.

Security by design as basic principle of IT security.

Current "security by design" approaches in international standardization must be pursued further. Voluntary certification processes defined on this basis are more effective than legally imposed certification. It is essential to avoid the legally imposed use of specific technologies or security components that are unable to keep up with the progress of technology.

Voluntary certification processes are effective.

5. Expansion and improvement of digital infrastructure

Expansion of the broadband network needs to be further accelerated to enable universal coverage for digitally driven innovations.

Improvements in the digital infrastructure may no longer focus exclusively on the needs of traditional user groups (for example, Internet service providers and end users). In the context of the Internet of Things, industrial users have requirements (for example, latency times, jitter, reliability, implementation of functional security, and the like) that must be more strongly considered in the fifth generation of mobile telephony. Only in this way can distributed industrial applications become possible using the public infrastructure.

Improvement of the communications infrastructure to meet the requirements of industrial applications.

In addition, upcoming 5G technologies will allow a functional expansion of the communications networks (for example, direct communication from a machine to a neighboring machine); during planning of this expansion, industrial requirements will also have to be a primary consideration.

Network neutrality must be maintained as a basic principle of network use. Preferential service quality may only be granted to those services that cannot be implemented without guaranteed service, such as security-critical applications. Preferential network access designed under these conditions must be available free of discrimination to all providers of such services. Differential service and pricing should not be misused as an additional source of income by network operators, or even reduce incentives to eliminate network bottlenecks.

Maintaining network neutrality.

Deficits in technical regulation must be eliminated quickly. The EN 300328 standard for wireless networks, which can serve as a textbook example of a technical regulation that utterly fails to address industrial requirements, must be reworked in its next revision. In addition, dedicated real-time standards and associated frequency bands are needed for wireless networks. In times when more and more machines have both a radio receiver and a transmitter, the current regulatory gray area between the Radio Equipment Directive and the current machinery directives must be cleared up.

Elimination of deficits in technical regulation.

6. Support for digital platforms and ecosystems

Digital platforms and associated ecosystems are the most important factor of a digital economy and society. Platforms use digital technologies to scale up a marketplace model, in which various interest groups (for example, merchants and customers) interact under specific conditions, to a global level. Digital platforms perform a wealth of different functions, from the exchange of goods and data to matchmaking. Platform participants can be companies, Internet users and, increasingly, devices and machines. The success of the IT industry in the United States is in large part due to the successful establishment of platform-based business models on the market. Platforms will also play a crucial role in the digitalization of Germany's economy and society, so they should be supported by modern economic and innovation policies.

Digital platforms: an important factor in the digitalization of the economy and society.

Digital platforms benefit from the network effect, meaning that the benefit for individual users of a platform increases with the number of users the platform has. As a result, platforms can tend toward oligopolistic or monopolistic market structures, as can be observed today with companies such as Google and Facebook. This does not, however, constitute a reason to hinder the emergence of successful commercial platforms with ex ante regulation, since in the worst case they would then emerge abroad. The existing legal framework, for example antitrust or data-protection legislation, should also suffice for platform-based business models.

No ex ante regulation of platforms.

In European innovation policy in particular, the establishment of noncommercial and open platforms is frequently singled out as especially worthy of support; FIWARE and possibly the Industrial Data Space can be considered examples. In principle, there is nothing objectionable about such platforms. It would, however, be wrong to promote noncommercial platforms in the hope of establishing a European counterpart for the commercially oriented U.S. Internet economy. There is no evidence that open and noncommercial platforms have greater economic benefits or are more effective for the digitalization of the economy and society. There are also still many important unresolved questions regarding noncommercial and open platforms, for example regarding the responsibility for their operation and further development. Above all, however,

Support for open, noncommercial platforms only in the event of market failure and not in competition with commercial offers.

platforms initiated or supported by the public sector may not enter into competition with existing or emerging commercial platforms in order to avoid distortion of competition to the detriment of businesses already participating in the market. Likewise, support of open and noncommercial platforms may not lead to a situation in which the emergence of commercial platforms receives insufficient support or is even hindered. Noncommercial platforms are only needed when a market failure prevents the creation of commercial platforms.

7. Development of standards

The role of standards in promoting digitalization should be neither under- nor overrated. Standards can support the development of a market, but they cannot create a market on their own.

Consensus-based standardization as a normal case, complemented by ad hoc consortia.

Consensus-based standardization within the established standardization organizations should remain the normal case. In individual cases, however, it may be useful to define standards outside the standardization organizations and without full consensus in consortia founded on an ad hoc basis. Such an approach should be neither generally condemned nor generally supported; it depends on the individual case.

Standardization: a voluntary, industry-driven activity.

Standardization is an industry-driven activity based on voluntary participation. It involves navigating between the opposing forces of agreement and competition. It is not unusual for products to be successful on the market and to become standards only later. Efforts to exert regulating or accelerating influences on standardization are generally ineffective.

Political support, particularly for systemic standardization.

For systemic standardization work, as in smart grid or Industry 4.0, what matters most is to create a reference architecture model to establish consistent language. In a suitable industrial alliance, the model can be used to derive specific standardization requirements in the form of a standardization roadmap, possibly supported by specific research projects or field tests. The same alliance can then submit these standardization requirements to the established standardization organizations and push their implementation. Policymakers can help with the founding of such alliances and by supporting the required research projects and field tests. Efforts by Germany to develop standards on its own would be deleterious to its export-based economy and are therefore to be strictly avoided.

8. Education and training

Placing digital technologies on the mandatory curriculum at all levels of education.

In the digital age, digital technologies must be part of the mandatory curriculum at all levels of school, vocational and university education. This applies for both the technical basics and their use. For example, raising awareness about the consequences of “cost-free” use of Internet providers is the most effective

protection against violations of privacy. This needs to be given due consideration during the preparation of school and university curricula so that digital skills improve in the general population. The objective is digitally informed citizens.

Fighting the shortage of qualified workers for critical skills.

Fighting the shortage of qualified workers for critical skills calls for carefully planned expansion of the corresponding school and university curricula as well as refinement of vocational training. Such educational offerings have to keep up with the digital transformation. For example, in industry needs are currently developing for skilled workers who can combine classical mechanical engineering with data processing technologies.

Placing digital technologies on the mandatory curriculum at all levels of education.

In addition, the digital transition must not be allowed to stop with the educational system. Digital technologies can help to improve teaching quality and to design more flexible educational offerings that can be made accessible to more people. These opportunities must be fully exploited.

Fighting the shortage of qualified workers for critical skills.

Given demographic trends, in order to ensure the availability of a sufficient critical mass of skilled workers, additional measures must be taken to increase the attractiveness of MINT subjects and the number of female students studying them.

Immigration as a lever for fighting the shortage of skilled workers.

Finally, there remains the fact that all the educational policy measures in Germany will not be enough to resolve the shortage of skilled workers. As a country of immigration, Germany needs to become more attractive to qualified specialists – from a clear immigration policy to a true culture of welcome.

9. Role model function of public institutions

In addition to supporting research projects and institutes, the public sector can make other important contributions to the digitalization of the economy and society.

Innovation-oriented public procurement.

In public procurement, in addition to minimizing procurement costs, it can make the promotion of innovative pilot projects and solutions an important secondary objective. Besides the creation of new digital services for citizens, this applies among other things to compliance with the latest IT security standards. Innovation-oriented public procurement makes a significant contribution to an innovation-friendly climate and creates incentives for businesses to react to public tenders with innovative bids.

E-government: role model function of public administration.

In e-government, the services and processes of public authorities and institutions also still have considerable potential to provide significantly improved services for citizens and businesses by using digital technologies and/or to perform duties on behalf of the state with significantly increased efficiency. It would be desirable if at least selected public institutions were to use digital flagship

projects with a high level of innovation to send a clear signal to all German and European stakeholders that policymakers and public administration are setting a good example in digitalization.

10. Public acceptance

Objectively and openly dealing with risks in public debate.

Biotechnology is a good example of how a lack of public acceptance can impede an emerging industrial sector in Germany. In the public debate, an excessive focus on the risks combined with a disregard for the potential benefits resulted in a climate hostile to innovation in which biotechnology was unable to thrive. A sober consideration of the opportunities and risks, including measures for risk reduction, did not take place.

Digitalization also involves risks that should be dealt with in an objective and open way in public debate in order to prevent hasty judgments and a lack of acceptance. Jobs can and will be lost due to digitalization, even though the losses will most likely be compensated for by the creation of new jobs. Pressure for qualifications will continue to rise. There may be fewer trainee positions and jobs for unskilled workers.

Credible social policy to accompany the digital transformation

The opportunities and risks of digitalization must be communicated with the required clarity to the citizens and voters. Including representatives of civil society in the framing of innovation policy, as is being attempted in the High-Tech Strategy, is an important first step.

More important still, however, is a credible expression of the political will to accompany digitalization with social policies and to ensure that the expected economic benefits will reach all social groups. Codetermination will continue to play a crucial role in actually shaping digitalization in individual businesses. In crucial phases of recent German economic history, cooperation between management and labor unions in businesses has repeatedly led to foresighted decisions and wise managerial actions for the good of all. In dealing with digitalization, management and labor unions must remain bound by this tradition.

Importance of innovation in government

The issue of innovation should be assigned even greater importance by politicians, and its significance for long-term economic and social success should be emphasized much more strongly in public debate. The effect of new laws and regulations on Germany's innovativeness and on the affected sectors should be analyzed, understood and accounted for more systematically than before.