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Industrial renaissance, advanced manufacturing and servitization: an Introduction

One of the consequences of the steadily rise in globalisation that has taken place since the end of the crisis in the late 1970s and early 1980s has been a reduction in the weight of the industrial sector in developed economies, especially in terms of employment. This process is related to the delocation or «off-shoring» of production operations, usually in search of a competitive edge based on lower labour costs. In the wake of this increasing deindustrialisation in the West, there is now an increasing awareness of the crucial importance of industry to advanced economies.

After many years of seeing manufacturing activity offshored to China and the Pacific Rim, interest began to grow in the USA in facilitating back-shoring processes, and in 2012 PCAST (the President's Council of Advisors on Science and Technology) advocated giving advanced manufacturing a more prominent role in domestic industry so as to make it more competitive and regain ground in the distribution of manufacturing activities in the global economy.

At the same time similar concerns for encouraging the revitalisation of industry were being voiced in Europe. Communication 2014 (14) of the European Commission, which bears the title «For a European Industrial Renaissance», states that manufacturing is essential for creating jobs, spurring growth across the continent and encouraging competitiveness. In that document the European Commission urged Member States to acknowledge the crucial importance of industry. It also established a number of priority actions required to encourage competitiveness in European industry: modernisation through investment in innovation, efficiency in the use of resources, new technologies and capabilities and access to funding.

In the context of the Basque Country industry and industrial policy have always been a key pillar of strategies for development. Manufacturing in the region is seen as a catalyst for innovation, job creation and added value for the economy as a whole, because it acts as a driver for other, non-industrial sectors. It should therefore be no surprise that *Ekonomiaz* is joining in the debate which has placed the revitalisation of manufacturing at the heart of public sector policies, particularly in view of the fact that this new industrial renaissance is inextricably linked to the profound transformation of the sector brought about by the two trends referred to as Industry 4.0 and servitisation.

Industry 4.0 is concerned with the rise in advanced manufacturing made possible by innovative technologies such as additive manufacturing, collaborative robots, sensorisation, telemetry, cyber-physical systems, augmented reality, cloud computing and big data analysis. It is a true renaissance for the sector, which is expected to have greater economic impact in the form of high, sustained growth in productivity.

The rise in servitisation stems from the fact that it is now understood that this industrial renaissance involves not only more sophisticated technology but also the need for innovation in business models, with a shift towards providing the market with offers based on systems covering both product and services. The term «servitisation» is used because the logic behind it is centred not on selling a tangible, physical object but on providing a service, thus increasing and enriching the value of manufactured goods through a range of other activities (installation, maintenance, advisory services, training, upgrades and updates in functions, monitoring of performance and wear, management support, etc). There is an upsurge in competition strategies based on services and on business models that strengthen the links between manufacturers and users; one of the keys to that strategy is for industrial firms to add intangible services and interfaces to their tangible products so as to permit connections and interoperability between devices and underlying functions.

In short, servitisation is a formula that can be used by industry to reinvent itself and regain importance in the economy as a whole, as indicated in publications such as the 2013 European Competitiveness Report *Towards Knowledge-Driven Reindustrialisation* and in *Smart Service Welt* (2015) by Acatech (the German Academy of Science & Engineering). This latter report clearly advocates a blend of the concepts of Industry 4.0 (and therefore of smart products and smart production, known as «smartisation») with the development of advanced services and the strengthening of links between suppliers and users of products and services (servitisation).

It must be noted that the concepts of Industry 4.0 and servitisation are tools for the revitalisation of industry, but at the same time they are levers that actors in the industrial sector must use if they are to be competitive. They provide both support for the renovation of the sector and its recovery in macroeconomic terms and a «filter» for competitiveness at the microeconomic level that enables those firms which are best able to adapt to their requirements to stand out.

In view of the political will that can be observed at various levels of government in regard to the repositioning of industry, we may be witnessing an interesting new scenario for industrial competition in which public sector policies may play an influential role. That competition takes place not only on an intercontinental level but also between regions, so it will be of interest, for instance, to see what policies and initiatives are adopted by the various regions of Europe.

Seeking to encourage this transformation in policies and in industry, this monographic issue tackles its theme via three blocks of articles: the first looks at reindus-

trialisation on the conceptual, macroeconomic and spatial levels; the second deals directly with advanced manufacturing; and the third focuses on servitisation.

The first block opens with an article by **Göran Roos** that describes the link between the concept of the economic complexity of a country and its welfare, and looks at the reasons why manufacturing, especially advanced manufacturing, constitutes a basis for national prosperity. It also examines trends in essential technologies that are likely to affect both manufacturing and service activities themselves and their impact on business and on society as a whole in terms of improvements in productivity, skills and job creation, forms of organisation and the global dispersal and concentration of activities for the creation of value. The author concludes that the technological developments that have taken place will have a positive effect on national prosperity in countries where there is a high level of economic complexity provided that suitable policies are implemented, especially as regards the development of a sufficiently large, highly qualified workforce. In less economically complex countries the prospects are less positive, and unless policies are successfully implemented to increase their complexity quickly national prosperity is likely to decrease, and this in turn is likely to have a negative effect on individuals as their skills prove unsuitable in a context of low demand for labour.

Gabriela Dutrénit gives an account of industrialisation in Latin America and of the difficulties that exist there in implementing processes of structural change. She discusses potential strategies for strengthening industry in the region, focusing on two approaches: one in which the model of development is based on the use of the natural resources available in each country and the other, in line with conventional development economics, based on manufacturing industry as the driving force behind the economy. The article seeks to examine the challenges faced by the region in general. The case of Mexico in particular is used to assess the advantages, drawbacks and difficulties of the two approaches.

Matilde Mas and **Eva Benages** then examine the debate of «manufacturing versus services» in terms of which sector provides better and greater economic growth. They apply two criteria to assess the arguments for each side: capacity for job creation and capacity for showing a positive rate of growth in productivity. Using the PREDICT database, which features a high degree of disaggregation and data drawn from the European Union and other countries, they conclude that the service sector meets both the said criteria but the manufacturing sector does not. They also highlight the importance of manufacturing and services subsectors based on ICTs and those which are not based on ICTs but are R&D intensive, due to their capacity for creating jobs and increasing productivity.

Closing the first block and providing a link to the second, the article by **Claire Dhéret** begins by analysing the key role of manufacturing in European economies and the difficulties that those economies encounter in maintaining a sound indus-

trial base because of the consequences of the recent crisis and the high-level of dependency of the economy on the financial and service sectors, in detriment to manufacturing. In view of the fact that the European political agenda now acknowledges the importance of manufacturing as a key sector for increasing growth and creating jobs both directly and indirectly, the article then examines what strategies can be implemented to lead to successful re-industrialisation in Europe. Taking into account economic globalisation, increasing competitiveness among emerging economies and the appearance of disruptive technologies, the article sets out three specific strategies: (1) promoting new business models; (2) creating industrial ecosystems through systemic innovation; and (3) favouring and fostering a genuine European value chain.

The article by **Mikel Navarro** and **Xabier Sabalza** begins by analysing the context in which the Industry 4.0 initiative emerged in advanced countries and assessing its potential by relating it to GPTs (General Purpose Technologies). They highlight the difference in the approaches taken in the USA, where the strategy is to open up more to such technologies as a whole, and in Germany where the initial position of industrial leadership has led to a greater focus on the digital revolution and the Internet of Things in drawing up a dual strategy for digitising industry (demand-side) and producing cyber-physical systems and components (supply-side). The article then goes on to look at the strategy in the Basque Country, referred to as Basque Industry 4.0. This strategy takes as its point of reference the strategy launched by the German government in the middle years of the decade, known as Industrie 4.0. The authors highlight certain criteria that may serve to adapt the strategy better to the characteristics of the production fabric in the Basque Country: a dual approach rather than suppliers and users, opening up not just to digital but also to other technologies and not only using them for support but integrating them into value propositions. The article ends with a number of critical recommendations concerning the organisation and deployment of this strategy and the participation of the various actors, bearing in mind the inherent complexity of the tasks involved.

Esperanza Marcos and **Mª Luz Martín Peña** describe the characteristics of Industry 4.0 and the challenges that must be faced, and then go on to examine the importance of having specialists with the right training to meet those challenges. They argue that such specialists must not only have specific, in-depth expertise and mastery of at least one discipline but also cross-sectoral skills that can easily be adapted to different disciplines; they need to be able to interact with people from other knowledge areas, and to successfully handle the management of multicultural, multidisciplinary teams in a globalised business, with user satisfaction as a determinant factor. The authors refer to these specialists as «T-shaped": they include service engineers, who define the scenario of total connectivity through continuous technological innovation and the proposal of solutions. They find, however that few universities currently offer undergraduate and master's degrees of this type, and suggest

that universities need to adapt their curricula if they are to successfully produce the new, T-shaped specialists required by Industry 4.0.

The block of articles on servitisation opens with a contribution by **Heiko Gebauer**, who takes a qualitative research study on the market for water treatment equipment based on new technologies as a basis for examining the capabilities and resources that firms operating in this new market segment need if they are to switch from supplying products to providing services during the initial stage of the life-cycle of the segment, when service provision is generally associated with firms whose products are already a mature. Using interviews and case studies, the author develops a resource capacity framework for services at the initial stage of the life-cycle of an industry. The article concludes that four critical resources are required to develop services successfully at this stage: (1) financial resources (external); (2) technological resources; (3) stock capital; and (4) service resources. If they are to become successful service providers firms need to deploy these resources through a number of specific capabilities that enable them to make good use of use-oriented PSSs (Product-Service Systems) from the outset of the business. This finding calls into question the assumption that product-oriented firms switch to use-oriented PSSs only at the mature stage of the life-cycle of an industry.

In the second article in this block, **Tim Baines**, **Ali Bigdeli** and **Carlos Galera** describe the main evidence obtained concerning the adoption of the strategy of servitisation, examining the intense debate ongoing concerning the rights and wrongs of favouring the service sector over manufacturing and where the desirable balance lies between services and manufacturing among businesses that see themselves as manufacturers and indeed in the economy as a whole. The authors hold that the conventional arguments in this debate do not stand up in practice, because OEMs (Original Equipment Manufacturers) themselves are turning into service providers, thus blurring the lines originally traced. Their conclusions are grounded on research using the Delphi method, with statements and opinions from 33 high-ranking executives at 28 organisations of different sizes, representing a cross-section of the production fabric in the UK. Their analysis focuses on five basic areas: (1) servitisation and advanced services; (2) the process of transformation: stimuli, incentives and organisational change; (3) impact on customers and manufacturers; (4) facilitating and inhibiting factors; and (5) the potential for firms and for the economy as a whole. Their findings are presented in the form of eight proposals which together help to extend knowledge of the strategic process adopted by manufacturing firms with a view to competing in services.

Bart Kamp ends the servitisation block with an explanation of the multiple facets of the concept: what it represents, why it tends to be misunderstood or overlooked and why it is important for industrial actors to assess the adoption of servitisation practices. He explains what advantages firms can obtain by implementing the ideas that underlie servitisation and how such ideas can help them stand out from their

competitors and increase customer loyalty. The article provides a sort of playbook manual for firms that wish to explore the pros and cons of potentially increasing servitisation in their businesses. He goes on to point out potential synergies between concepts such as Industry 4.0 and servitisation through the smartisation of products, production processes and relations with customers; it shows how such smartisation can, along with increased use of ICTs, leverage the trend towards servitisation among industrial firms. The article thus provides a bridge between the concepts of Industry 4.0 and servitisation. It also examines three types of obstacle that may prevent firms from increasing the level of smartisation of their businesses, and concludes with recommendations for industrial firms and political decision-makers.

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Finally, in the «Other Contributions» section, **Joan Rosselló** and **Andreu Sansó** examine the funding of the regional autonomous communities within the Spanish public system, analysing the factors that explain the current tax balances of the autonomous communities. Empirical findings suggest that: a) the long-term deficit targets set should not be distributed in a linear fashion or indeed over the same time frame for compliance in different regions; b) funding agreements should be redesigned to prevent the central government from being able to transfer deficits to the autonomous communities; and c) there should be greater budget coordination to prevent autonomous communities from evading spending and borrowing constraints through their instrumental public sectors.