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Technology, Innovation, and Occupational Skills in the Knowledge Society

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To grapple with the future of work necessarily means to reexamine the concept of *skill*. The debate on the alleged historical tendency towards the deskilling of work—understood as a process whereby productive skills and competencies are expropriated—must be unlinked from the benefit provided by a given piece of technology. At stake in any technological change is a set of social relations both within and beyond companies and a set of institutions that regulate the application of that technology. The fields of those institutions range from science and technology to production, from the educational system, and lifelong education and training, to labor markets and their specificities. An innovation system is more than the generation of new technologies and processes: it is a political and social phenomenon, a new techno-economic paradigm.

The new knowledge society, unlike nineteenth- and twentieth-century work-organization models, requires productive paradigms open to learning communities where workers' skills and continuous training and education are central to technology management. More and more, the skill sets required are polyfunctionality, versatility, and social skills such as the ability to communicate and cooperate across interconnected work processes. Productivity and efficiency are less and less based on intense physical work and more and more on intense knowledge yielded by processes of analysis and synthesis applied to solving operational problems. The demand for greater autonomy and accountability requires more complex and faceted general education, permanent training in specific skills, and the deployment of transversal skills. Skilled work today means something quite different from what it meant in the last century.

This chapter provides a conceptual analysis of the effect of technological changes on the interrelated phenomena of employment and skills. In the age of the mass informatization of employment, we examine in particular the decline of occupations that require performing routine tasks without making important decisions, occupations that can be easily codified in algorithms and programming sequences. Automation in this case means replacing certain tasks performed at a job, redefining the complexity of its content without any major impact on its quantity. That diminishes the impact of automation on employment but not on skills, since the nature of the tasks performed changes. Knowledge society acts on production models when it generates a critical mass of skills that requires new management capabilities. Whether or not innovations are actually and meaningfully incorporated in an organization depends on the skills acquired by its technology and management teams (engineers, technologists, specialists, and middle management) and on the abilities, capacities, and *habitus*[1] reinforced in its workers.

[1] The notion of *habitus* developed by Pierre Bourdieu designates a referential scheme of action constructed in environments of primary socialization over the course of a lifetime; a *habitus* is an overdetermining factor in our perceptions a

The changes in the organization of processes and the cognitive skills necessary to carry out the so-called Fourth Industrial Revolution on a micro-economic level are a challenge facing today's institutions. These changes will ensue over the course of a period during which work must be reorganized and workers re-skilled as technologies are gradually adapted to work environments. New social relations are required between actors and systems, and new interactions and common codes must take shape to make it possible to combine innovation systems, on the one hand, and highly competitive economies or segments of economies and strong formal and non-formal educational systems, on the other. Innovation systems must coordinate with public policies that strengthen sectors strategic to the pattern of specialization capable of sustaining a country's production system, creating an appropriate judicial framework and stimulating new productive visions and visions of the relationship with science and technology. With these concepts, new occupations will not be the simple outcome of the application of new technologies, but—depending on the policy decisions made by key actors—actually fuel a redefinition of questions like level of employment, skill, and hiring and working conditions.

New processes of automation and robotics, then, will not necessarily mean replacing human beings, but they will require them to acquire new skills, more cognitively complex and less routine skills that entail making decisions about issues that computers are not equipped to. A good strategy for Argentina would be to bolster the quality of its workforce, favoring production diversification and the training of workers in medium- and high-skill areas. A labor market with these characteristics improves workers' bargaining position, employment stability, working conditions, and compensation. The debate revolves around the short-term diagnosis: can we expect a polarization of skills or will we follow the trend in developed countries and vitalize the demand for mid-level skills?

Educational and training systems must provide open-ended skills and engage in permanent instruction, since many of the abilities required in the future are unknown. In that framework, it is essential to generate the ability to learn and to transfer knowledge and skills from one field to another. In the next decade, workers will be required to have cognitive skills and abilities not confined to training in a single area. At stake are *meta-skills*, that is, skills that go beyond any specific content, technique, or procedure. These *meta-skills* are tied to a new intellectual matrix that generates the ability to operationalize competencies, to apply them creatively in order to work out real problems.

Key to this is the concept of *lifelong learning* embraced by the UNESCO, where emphasis is placed on educational policies that recognize the importance of ongoing training in a world where citizens and workers are facing constant change. In Argentina, the three main actors in employment and workplace training are the State, management, and workers through their unions. Of the three, the State has the greatest power to gather individuals, to develop strategic instruments, and to finance and implement employment training efforts. Employment training has been governed by flexible and disjointed parameters; the construction of a continuous education and training system requires that the State establish regulatory instruments to provide that system with coherence, consistency, and social recognition. That does not mean unifying or "formalizing" employment training, but rather establishing quality parameters and a distinct set of goals and practices. In the near future, continuous education will require a profound reconsideration of devices to coordinate the levels of the formal and non-formal educational system.

decisions. This concept is at play in intangible institutions and their interventions, and even in the vocational skills workers develop.

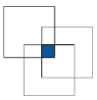
To increase efficacy, these changes must be accompanied by a critical social dialogue between actors from the productive sector, labor, science, technology, and education.

Where does Argentina stand in the creation of a continuous education system? In the sphere of education and training, institutes like the Consejo Nacional de Educación Técnica [National Council for Technical Education, CONET] and the Instituto Nacional de Educación Tecnológica [National Institute of Technological Education, INET] and, starting in 2006 and through September 2018, the Ministerio de Trabajo, Empleo y Seguridad Social [Ministry of Labor, Employment, and Social Security, MTEySS] have been key players in the creation and proliferation of other institutions that provided training at different skill levels. In terms of the construction of a future system, the Consejos Sectoriales Tripartitos [Tripartite Sectoral Councils] were central to the MTEySS as spaces to build consensus on the implementation of active employment policies (search for employment, labor intermediation and insertion), training programs, and skill certification. Crucial as well was the strategic decision to create a program of continuous improvement aimed at strengthening existing training institutions. That policy was developed in the framework of an agreement with the Instituto Argentino de Normalización y Certificación [Argentine Normalization and Certification Institute, IRAM]. It yielded a set of quality references endorsed by a group of training institutions. A large number of institutions, then, formed part of this continuous improvement program in which they received technical assistance to develop protocols for each of the work processes indispensable to their inner operations. Once it had a solid core of institutions, the MTEySS created another device that had enormous impact: the Red de Instituciones de Formación Continua [Network of Continuing Education Institutions]. This network consolidated and provided guidance to a set of training institutions that had quality assurance processes underway or were already certified.

On the basis of these theoretical reflections and lived experiences, we would like to underscore the importance of creating, in response to major innovations, a feedback spiral of learning experiences coordinated by multiple sources: the production system, the science and technology system, the lifelong educational and training system, and the competencies and skills that workers deploy in the workplace. In addition to investment in technology, technological changes require the strengthening and development of formal and non-formal educational systems and of public policies that incentivize strategic sectors. The depth and strength of a society's innovation processes depend on companies' technological and organizational capacities, on the impetus fostered by the State to favor those processes, and on the contribution that the educational, and science and technology, systems make to providing suitable and skilled personnel.

The advance of digital technologies, communications, robotics, new materials, artificial intelligence, and big data will help improve the wellbeing of the population provided institutions take precautionary measures by making basic and complementary investments. With those investments, that advance will lead to a development model that distributes income, provides the population with access to education and health care, and fosters strategies to reduce inequalities that might result from or be reinforced by those technological advances. It is necessary to rethink employment training and current learning models in order to tackle the cognitive challenges of the future, challenges that new technologies bring to the daily life of citizens and workers. That is the only way economic productivity will lead to a better quality of life, to greater income, and to more and better employment.

Full document (PDF)



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