Looking at discontinuous change through a *Systemic Competitiveness* lens

The World Economic Forum (WEF) is raising the awareness of global leaders about the expected societal changes as the Fourth Industrial Revolution expands. The WEF claims that this Fourth Industrial Revolution is different from any preceding revolution due to its velocity and exponential rate, breadth and depth of convergence and its systemic impact on industries, firms, governments and whole societies.

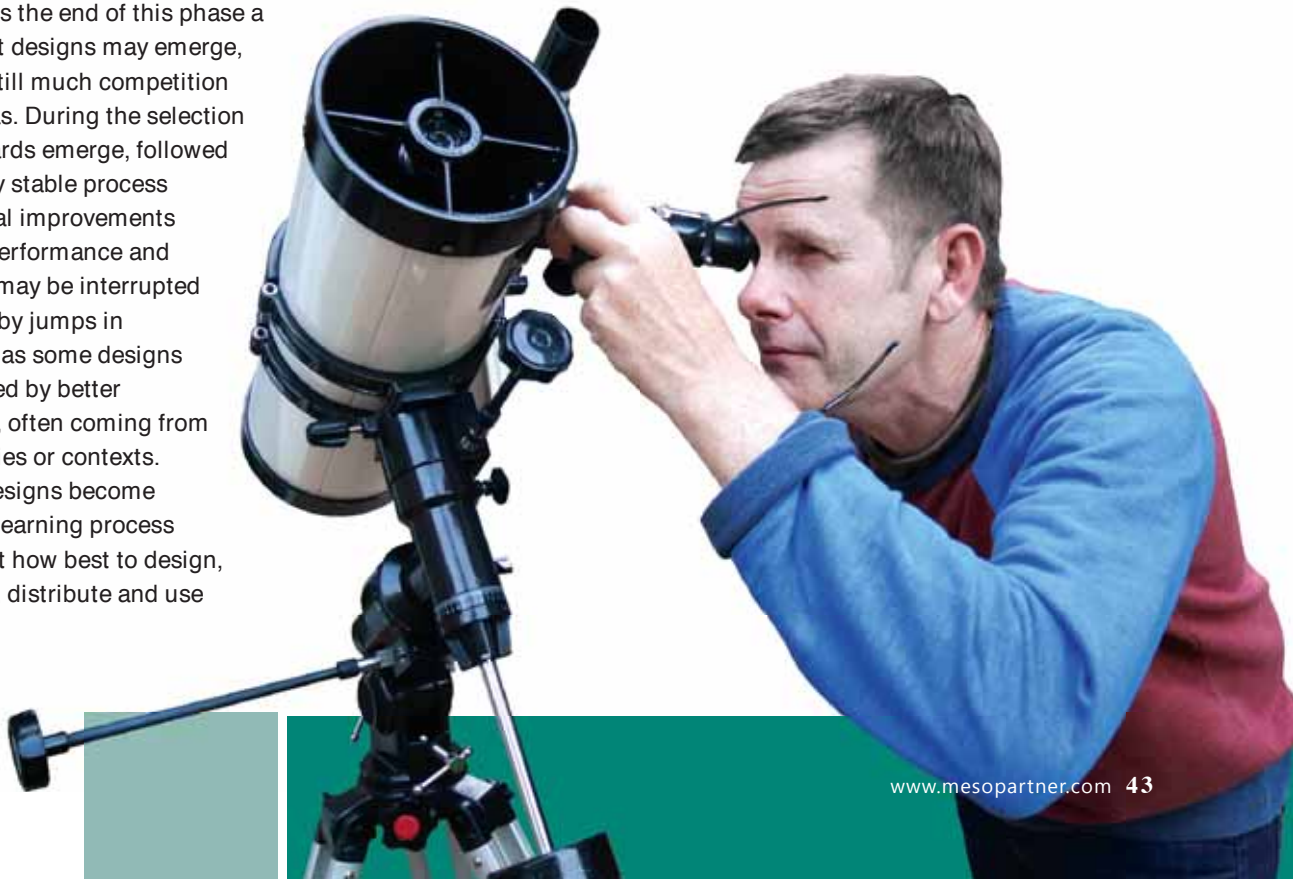
Some argue that the Fourth Industrial Revolution is not a revolution at all, but merely an extension of the third revolution, with connectivity stretching from the office to the factory and the farm. Besides, it is always hard to predict the outcomes of revolutions because existing technologies, industries and even organisations are disrupted or become obsolete. Technologists and some scientists argue that massive paradigm shifts are

hard to anticipate because existing actors are pursuing incremental (linear) improvements and cannot imagine whole architectures and technical systems becoming obsolete.

However, what is clear is that there is a huge convergence of technological advancements over many domains, largely made possible by more powerful digital processing capabilities, connectivity and scientific breakthroughs in biology and material sciences. What is uncertain, however, is the speed of this change and how widespread the effects will be.

How do technologies evolve? Briefly, technologies evolve through a process of variety creation, selection and then amplification or retention. During the variety creation phase, there are many competing designs and no dominant logic. Towards the end of this phase a few dominant designs may emerge, but there is still much competition between ideas. During the selection phase standards emerge, followed by a relatively stable process of incremental improvements in features, performance and results. This may be interrupted occasionally by jumps in performance as some designs are substituted by better technologies, often coming from other industries or contexts. In general, designs become simpler as a learning process unfolds about how best to design, manufacture, distribute and use a particular technology. This leads to an amplification phase, where the best ideas are not necessarily used as intended, but where technological changes make their way into areas where they were not originally intended to go. It is here where economies of scale are pursued and costs are reduced in production, distribution and use. This is a relatively stable process that can continue for long periods, until is it suddenly interrupted by a radically different idea, resulting in the process starting all over again.

Two kinds of technological discontinuity can be identified. The first is competence enhancing, meaning that current users of this technology are able to build on previous



experience, qualifications and knowledge. This could be incremental or radical, but the old technological domain is not entirely lost and is even sustained.

Then there is competence-destroying change. Here past experience, qualifications and knowledge are made obsolete.

Due to inertia and path dependence, competence-enhancing change often favours incumbents and existing users, while competence-destroying change favours newcomers.

What does this mean for the systemic competitiveness of developing countries, and especially for meso organisations? In our work on technological capability, we apply four factors originally identified by Hillebrand et al. (1994).

- The first is a competitive micro level where new ideas can be tried, and where resources are allocated in a process of competition and collaboration through markets, hierarchies and networks. This is about the skill of the producers to imitate and innovate at product, process and business model levels.
- The second is indirect support by the public and private educational systems. In addition to a sound basic education, it is important that technical training of a suitable quantity and quality is available at secondary school level and also in the universities. The private sector often plays a role in short-term training aimed at particular technology applications. Overall the education sector must be able to identify and respond to changes in the application, development and use of technology in society.

- The third group is what we refer to collectively as technological institutions. Direct support by technology-oriented state institutions or specific types of knowledge-intensive service companies depends on the existing level of development, the competition situation and the characteristics of a technology branch in the given country. These organisations disseminate technical and expert knowledge between different actors, knowledge domains and industries, and play a critical role in the use and application of tacit and explicit knowledge.
- The fourth set of factors relates to the framework conditions created by the meta and macro levels in the systemic competitiveness framework. It is about how a society learns, how it handles disagreement and broad social agreements about a desired future (see Article 12: Why should we work on the meta level, even if it's difficult?). The economic, political, administrative and legal framework conditions determine whether there are incentives to develop technological capability. The framework conditions both shape the meso and micro levels, and in turn are shaped by them.

These four factors combined determine the technological capability of a society or industry. The factors are connected through a dynamic process of engagement, dialogue, exchange and adaptation, with a range of mediators playing an important role in articulating change or amplifying the need for change, and transferring information between different groups. These intermediaries could have a formal role, for instance carried out by a government programme, or an informal role, carried out by activists, individuals, social organisations, leading enterprises or organisations going

beyond their formal mandate to encourage change, exchange and learning.

Due to the evolutionary nature of technological change, meso organisations that enable individuals, enterprises and networks to experiment or engage with new ideas at reduced costs and risks are essential. Literally, organisations that help innovators to learn by doing, or that demonstrate the potential of new technologies, are essential to assist, enable and stimulate technological change. At the same time, responsiveness in public organisations is increasingly important as technological change settles in. Education programmes must adapt, research centres may have to refocus, and entrepreneurship support may have to be adjusted. An advanced function is to try and assess the potential of new technologies to destroy current capabilities and competencies, and then to put programmes in place to retrain workers, repurpose infrastructure and manage the difficult socio-economic change that may result. Organisations must be increasingly flexible and adaptive.

Where technological change is expected to be competence enhancing, training programmes, upskilling programmes and supportive infrastructure may enhance the uptake of productivity-enhancing change, while drawing in labour and investment and paying attention to inequality, marginalisation and the environment.

Successful absorption of changing technologies may require new organisations. Also, it may involve different incentives for firms, scientists, technologists, institutions and even individuals. Some technologies may require little public support, while others would not develop or be mastered without it.

For policy makers and practitioners, technological change demands vigilance and flexibility. Many of the new technologies included under the banner of the Fourth Industrial Revolution are presented as physical technologies, but not much is said about social technologies and organisational innovations that may be required to successfully master, integrate and sustain new technologies. Often insufficient attention is given to learning about new technology, new forms of organisation required, technology demonstration and integrating learning from new technologies into existing capabilities.

However, we argue that the focus should not be so much on the technologies per se, but on the technological capability as we outlined earlier. The dynamism and absorptive capacity of a country, a region or inter-connected industries is much more important in determining whether new ideas are taken up, integrated, leveraged or ignored. Also, constantly refining, adjusting and expanding the range of meso organisations that support experimentation, searching for new ideas and discovery of different applications of new ideas are as important as the technologies themselves.

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