High Technology and Barriers to Innovation: From Globalization to Relocalization

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Abstract

We live in an era when a remarkable number of new information and other technologies are successfully bypassing the main obstacle to technological advance: technology support network (TSN). Technology support net, when fully established and fixed, erects significant barriers to innovation. Innovation is not free and autonomous process of applied creativity, but is technically, economically and politically subservient to the "holders and owners" of the support net. We present operational definitions of technology and high technology which explain past and current barriers to innovation shifts from one technological paradigm to another. The TSN-bypass technologies are causing the process of globalization to slow down and revert itself into a process of relocalization, bringing forth the economy of autonomous, self-reliant and self-sustainable individuals, communities, localities and regions.

Keywords: High technology, technology support net, barriers to innovation, continuous improvement, discontinuous improvement, globalization, glocalization, relocalízation, corso and ricorso, self-service, disintermediation, mass customization, 3D-printing, vertical farming

This paper presents a thesis that globalization brings forth reversive processes of relocalization. This constitutes a part of a larger project on management and economics of company as a living organism [22]. The evolution of technology, economic sectors and social systems in general, follow the shape of universal history, i.e., ***S***-curves of expansion-plateau-contraction. Any "progress" is self-limiting and subject to transformation in a *corso-ricorso* cycle of Vico [11]. We start with the insight of Cyril S. Smith, the master of innovation, who understood that all change that results from novelty is necessarily discontinuous [9]:

"A new thing of any kind whatsoever begins as a local anomaly, a region of misfit within the preexisting structure. The first nucleus is indistinguishable from the few fluctuations whose time has not yet come and the innumerable fluctuations which the future will merely erase. Once growth from an effective nucleus is well under way, however, it is then driven by the very type of interlock that at first opposed it: it has become the new orthodoxy. In crystals undergoing transformation, a region having an interaction pattern suggesting the new structure, once it is big enough, grows by demanding and rewarding conformity. With ideas or with technical or social inventions, people eventually come to accept the new as unthinkingly as they had first opposed it, and they modify their lives, interactions and investments accordingly. But the growth too has its limits. Eventually the new structure will have grown to its proper size in relation to the things with which it interacts, and a new balance must be established. The end of growth, like its beginning, is within a structure that is unpredictable in advance."

This observation applies to evolution, development and history in physical, biological, social and human world, and so it does to the ideas of this paper too.

1. HIGH-TECHNOLOGY CYCLE

There is a persistent myth that the rate of innovation is a function of invention, creativity and „pushing the envelope“ or „thinking outside the box“. People are being trained in imagination, brainstorming, creative thinking, overcoming resistance to change, effective teamwork, and similar functions, in order to overcome such „barriers to innovation“. These are, of course, all *necessary*, but far from being *sufficient* conditions for effective and successful innovation.

The main barrier to innovation is a part of technology itself: its infrastructure and technology support network, which over time can become vast, rigid, heavily invested and protected by its „owners“, that is by business and political interests of considerable power, resistance and determination.

The notion of technology has to be carefully defined as a form of social relationship, with hardware and software being enabled by brainware and technology support network (TSN). One can transfer hardware or software, but what about knowing what to do and why, or how to construct support network and infrastructure necessary for effective functioning of technology? Such crucial aspects of technology cannot be transferred: they have to be developed and evolved *in situ*, in each country or region seeking technological advance.

„Implementing a new technology in a rather different environment is itself a creative act, not just a copied behavior. Getting a complex technical system to function near its norms and repairing it when it malfunctions are activities drawing upon a slowly accumulated reservoir of tacit knowledge that cannot be easily transferred or 'downloaded' to a developing country.” [Stiglitz, 1999].

Information can always be “downloaded,” but knowledge cannot. Knowledge has to be produced within the local circumstances and structural support.

1.1 Technology definition

At its most fundamental, technology is a *tool* used in transforming inputs into products or, more generally, towards achieving purposes or goals.

Technology is a package of hardware, software, brainware and the support net. In many modern technologies, the hardware is becoming a commodity, the least decisive component, a mere physical casing for the real power of effective knowledge contents. The enabling infrastructure, or technology support network, is becoming the most important component of technology.

Any technology can be divided into several clearly identifiable components [13]:

1. *Hardware*. The physical structure or logical layout, plant or equipment of machine or contrivance. This is *the means* to carry out required tasks of transformation to achieve purpose or goals. Hardware therefore refers not only to particular physical structure of components, but also to their logical layout.
2. *Software*. The set of rules, guidelines, and algorithms necessary for using the hardware (program, covenants, standards, rules of usage) to carry out the tasks. This is the *know-how* – how to carry out tasks to achieve purpose or goals.
3. *Brainware*. The purpose (objectives and goals), reason and justification for using or deploying the hardware/software in a particular way. This is the *know-what* and the *know-why* of technology. That is, the determination of what to use or deploy, when, where and why.

These three components are interdependent and equally important. They form the *technology core*. There is also a fourth and the most important aspect of technology:

4. *Technology Support Net.* The requisite physical, organizational, administrative, and

cultural structures: work rules, task rules, requisite skills, work content, standards and measures, styles, culture and organizational patterns.

Any *technology core* (hardware, software and brainware), in order to function as technology, must be embedded in a supportive network of physical, informational, and socioeconomic relationships which enable and support the proper use and functioning of a given technology. We refer to such a structure as the *technology support net* (TSN), as sketched in Figure 1.

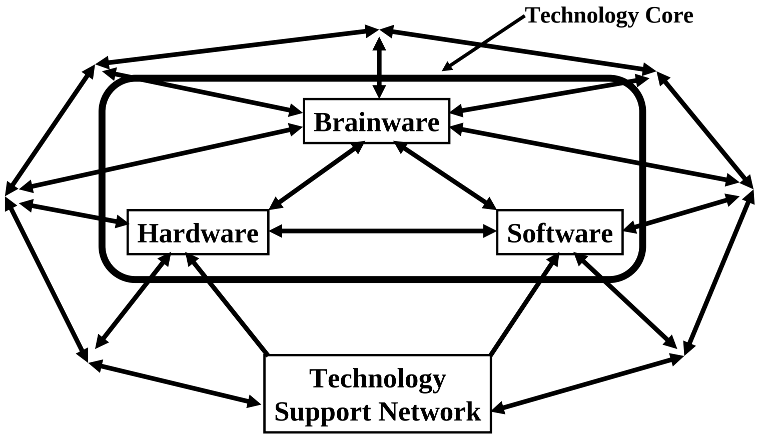

Figure 1 - Structure of technology

TSN is a network of flows: materials, information, energies, skills, laws, rules of conduct that circulate to, through and from the network in order to enable the proper functioning of the technology core and the achieving of given purpose or goals.
Every unique technology core gives rise to a specific and requisite TSN and thus to a specific set of relationships among people. Ultimately, the TSN can be traced to and translated into the relationships among human participants: initiators, providers and maintainers of the requisite flows in cooperative social settings.
In this sense, every technology is *a form of a social relationship* brought forth from the background environment. For example, automobile TSN consists of an infrastructure of roads, bridges, facilities and traffic signals, but also of maintenance and emergency services, rules and laws of conduct, institutions of their enforcement, style and culture of driving behavior, etc. A large number of people have to be organized in a specific and requisite pattern in order to enable cars to function as technology.

1.2 High Technology

Different changes in the core, both in hardware or software and brainware, will have differentiated effects on the requisite TSN. According to the nature and extent of such changes, we can offer the following definitions:

1. *High technology* is any technology core that changes the very architecture (structure and organization) of the components of the technology support net. High technology therefore transforms the qualitative nature of tasks of TSN and their relations, as well as their requisite physical, energy and information flows. It also affects the skills required, the roles played, the styles of management and coordination – the organizational culture itself. In short, it allows (and often requires) not only to *do things differently* but often to *do different things*.
Clearly, high technology should be differentiated from [regular] *technology*:

2. The *technology* core affects *only* the efficiency of flows over the TSN, i.e., it activates

quantitative changes over the qualitatively identical architecture of the TSN. It allows users to perform the same tasks in the same way, but faster, more reliably, in larger quantities, or more efficiently, while preserving the qualitative nature of flows and the structure of the support, skills, styles and culture. Technology allows us to do the same thing, in the same way, but more efficiently.

3. The *appropriate technology* core essentially preserves everything: the support net as well as the flows through it; its effects are *neutral* with respect to the TSN. It allows users to do the same thing in the same way at comparable levels of efficiency. Improving efficiency is not the purpose here, preserving and protecting the TSN is. Appropriate technology is very important in situations where the stability of the support net is primary for social, political, cultural or environmental reasons.

The notion of high technology is therefore relative to the referential point of the technology being replaced. No technology remains fixed and – being a form of social relationship – it evolves. Technology starts, develops, persists, mutates, stagnates and declines – just like a living organism.

There is an *evolutionary life-cycle* perceived in the use and development of any technology or business [5]: a new high technology core emerges and challenges existing TSNs which are thus forced to co-evolve with it. New versions of the core are being designed and fitted into an increasingly appropriate TSN, with smaller and smaller high-technology effects. High technology becomes just [regular] technology, with more efficient versions fitting the same support net. Finally, even the efficiency gains diminish, emphasis shifts to product tertiary attributes (appearance, style) and technology becomes TSN-preserving appropriate technology. This technological equilibrium state becomes fixated and stable, resisting to be interrupted by a technological mutation – new high technology appears and the cycle is repeated.

For example, automobile was high technology with respect to the horse carriage, it however evolved into technology and finally into appropriate technology with a stable, unchanging TSN. Main high-technology advance in the offing is some form of electric car – whether the energy source is the sun, hydrogen, water, air pressure or traditional charging outlet. Electric car preceded the gasoline automobile by many decades and so its return is quite natural in view of comparative costs displacements.

2. TSN AS A BARRIER TO INNOVATION

Implementing new high technology is often resisted. The electric car will be resisted by gas-station operators in the same way automated teller machines (ATMs) were resisted by bank tellers and automobiles themselves by horsewhip makers. On the contrary, technology does not qualitatively restructure its TSN and therefore will not be resisted and never has been resisted.

The proverbial "Resistance to change" is not a universal human trait. In fact, humans mostly like change, seek it out and thrive on it – as long as the change preserves the support network they are part of. The electric typewriter, electric tooth brush or a more powerful tractor were never resisted. Technologies and appropriate technologies are not resisted, high technologies are.

Middle management resists business process reengineering because BPR represents a direct assault on the support net (coordinative hierarchy) they thrive on. Teamwork and multi-functionality is resisted by those whose TSN provides the comfort of narrow specialization and command-driven work.

2.1. Examples of TSN-barrier

As the automobile has become *appropriate technology* of today, there is an ongoing transformation molding automobile into a high technology again. The accelerating capabilities of electromobiles, are *bypassing* the entrenched internal combustion engine TSN towards the high technology transformation of the automobile [19].
Yet, the idea of electromobile and its *distributed engine* is a century-old idea of the Bohemian designer Dr. Ferdinand Porsche. In fact, electromobiles preceded gasoline engines by some ten years. In the early 1900s, a 25-year old Porsche of Hofwagen-Fabrik Jakob Lohner & Co. developed electrically powered wheels and used them in roughly 300 different vehicles. In Amsterdam, for instance, both the fire brigade and "Amstel" brewery trucks briefly drove with his distributed-engine type of traction.
All these innovations, later upstaged by the low cost of gasoline engine, have disappeared from automobile evolution for some hundred years. The gasoline-based TSN has proved to be an insurmountable barrier to any electric advances. Countless inventions and improvements have ended up in the safes of automakers and Big Oil capital interests.
Among the most recent victims of the TSN-barrier were, for example, the Czech "elektromobil" EMA-1 from 1969 (http://www.stream.cz/video/296931-elektromobil-ema-1) and the General Motors electric vehicle EV1, evolved from the ZEV (Zero Emission Vehicle) mandate for California of the 1990s. In this case the power of TSN interests was so ruthless that in late 2003, GM officially cancelled the EV1 program, despite the growing waiting lists, positive feedback from the users and accelerating movement towards ZEV laws. All EV1 leases required return of the vehicle at lease end; the last private EV1 lease expired in August 2004. All of the vehicles were scrapped and destroyed at the GM Desert Proving Grounds in Mesa, Arizona, much to the protest of their former users. GM similarly disposed of 492 copies of its *Chevrolet S10EV electric pickup truck.* Such is the power of the TSN inertia and big oil lobby that even the most successful inventions cannot become innovations, even at the cost of the squandering potential technological advantage GM built through this program.
So, how does one encourage effective innovation of the high-technology type? The focus must be on *bypassing* the existing TNS. It is not sufficient to be creative and inventive. Instead of waiting „100 years" one has to concentrate not just on hardware-software-brainware core, but on the main barrier to innovation, the TNS itself,
So called „*continuous improvement*", is not facing any obstacles: it is continuously adjusting and fitting innovation to the existing TSN. Through the myriads of daily improvements, it ultimately achieves a perfect fit between technology core and its support net, the appropriate technology. Such continuous tiny advances end up in changing shapes, names and colors, while preserving TSN investments *ad infinitum*.
One cannot continually improve a horse carriage and some how stumble upon an automobile. The only outcome of such innovation is an „incredible horse carriage" – all titanium and carbon composites, with golden initials, overwhelming gadgetry and shimmering colors, but still a horse carriage.

2.2. Overcoming the Barrier

What is needed for meaningful innovation is „*discontinuous improvement*" leading to high technology, disrupting the old ways and old interest, lifting up human spirit and advancing human condition in leaps and bounds. That is where the TNS-barrier becomes visible, active and powerfully defended. That is when bypassing the existing TSN becomes the only way out for mankind, barring catastrophic price changes in resources and inputs of the old technology. Such widespread changes, transforming companies into *innovation factories* [17], cannot be resisted and ultimately dismantle the old TSN and transform the interests. But waiting for such spontaneous processes could become a long and wasteful wait indeed.

In the meantime we end up with a Toyota-type car with 30.000 different parts, screwed and soldered together, mechanical, electronic, glass, wood and metal all. One missing part and the whole supply chain gets disrupted, in failing part and the whole contraption goes out of kilter, subject to endless recalls. We end up with a far cry from an integrated, solid state electromobile, with a few mechanical components, no moving parts other than wheels (generating their own electricity), modularly designed and assembled, easily maintained and repaired, quiet and clean with respect to the environment.

Yet, the technology and knowledge for such a „laptop-kind“ design is widely available and accessible for decades and the only serious obstacle was the gasoline-based TNS and its overinvestment.

The *TSN-bypass strategy* of innovation is emerging on all front of human endeavor, not just in automobiles. Within the framework introduced here, one cannot fail to observe that modern information- and knowledge-based technologies tend to be *high technologies* with high-technology effects. They integrate task, labor and knowledge, transcend classical separation of mental and manual work, enhance systems aspects, and promote self-reliance, self-service, innovation and creativity. The *"low" technologies*, no matter how new, complex or advanced, are those which still require the dividing and splintering of task, labor and knowledge, increase specialization, promote division and dependency, sustain intermediaries and diminish initiative.

3. NEW HIGH-TECHNOLOGY TRENDS

Among the emerging new technology trends, which are all directed towards empowering the individual and increasing self-service, self-help, disintermediation, mass- and self-customization, among others, we can list at least the following [1]:

Distributed Co-creation, Open-source innovation and Co-ware. Companies can now create value through social networks and web communities. More than 68 million bloggers post reviews and recommendations about their products and services. Companies like Intuit host customer support communities for its financial and tax return products, where more experienced customers give advice and support to those who need help. Viral and word-of-mouth marketing is becoming pervasive and unmatched in its effectiveness. Co-creation is a two-way process: companies must provide sufficient feedback to stimulate participation and commitment. Open-source innovation taps the creative resources of customers, consumers and users. Co-ware supplements traditional software and brainware to support and streamline collective and collaborative efforts across ever larger interconnected communities.

Social-network Organization. No company is an island. Traditionally rigid corporate boundaries are becoming permeable: companies are reaching outwards but also letting the external world in. The work is being organized around critical tasks, not around rigid corporate structures and hierarchies. Now companies can map information flows and knowledge resources among their worldwide staff. New innovation communities can be set up across separated silos of traditional business units. Expanding and tapping into a world of talent beyond the limits and "inbreeding" pitfalls of full-time employees, a variety of innovative employment arrangements is emerging. Network organizations will focus on the *coordination* of tasks, not on the "ownership" of workers.

Collaboration Technology and Tools. The number of knowledge workers has grown much more quickly than of production or transactions workers. Increasing the productivity of knowledge workers is now more critical that that of highly automated production workers. Collaboration enhancing and coordinating technologies are designed to improve knowledge workers' efficiency and effectiveness. Collaboration tools, like video conferencing and shared electronic workspaces (allowing people in different locations to work on the same document simultaneously) are radically reducing travel budgets. Instead of moving around physical bodies, it is their brainware that moves around the world. Sharing of open-collaboration databases in medicine, intelligence, engineering, etc. are based on mapping the informal pathways through which information travels, how employees interact, and where wasteful bottlenecks lie. Understanding knowledge and knowledge work is becoming crucial.

From Internet of Symbols to "Internet of Things". The widespread adoption of RFID (radio-frequency identification) allows the things – i.e. assets themselves, not just their descriptions – to become elements of an information system. This "Internet of Things" makes objects, embedded with sensors, actuators, and communications capabilities, able to absorb and transmit information on a massive scale or to adapt and react to changes in the environment automatically. Such "smart assets" can make processes more efficient, give products new capabilities, and spark novel business models. Installing sensors in customers' vehicles revolutionizes auto insurance. Automobiles can automatically take evasive action when accidents are about to happen. Sensors embedded in or worn by patients continuously report changes in health conditions to physicians. Sensors in manufacturing lines take detailed readings on process conditions and automatically make adjustments to reduce waste, downtime, and costly human interventions.

Enterprise as a Laboratory. Business experimentation on a large scale can change the enterprise into a full-time laboratory. We can now analyze every transaction and capture insights from every customer interaction *immediately*. Asking *What if questions* from the "big data" supports continuous business experimentation that guides decisions and tests new products. Financial products can be tailored to individual risk profiles. Retailers can gather transaction data on millions of customers, adjust prices and promotions daily, gauge the immediate impact of marketing campaigns and understand how consumer sentiment about brands is changing. However, to accept the value of experimentation is not yet a part of culture, skills and knowledge of most managers.

Sustainable World, Self-sustainable Company. Environmental sustainability is fast becoming an important corporate-performance metric - one that stakeholders, outside influencers, and even financial markets have begun to track. The use of IT in areas such as smart power grids, efficient buildings, and better logistics planning could eliminate five times the carbon emissions that the IT industry itself produces. "Green data center" technologies use distributed co-creation and the Internet of Things to reduce the environmental impact of their IT. Utilities everywhere are deploying smart meters and smart grids to reduce the amount of power generated by costly peak-load facilities and to improve the efficiency of the transmission and storage of energy from renewable-energy sources. *Distributed energy generation*, like the Bloom Box technology, is ultimately going to eliminate the need for electric grid altogether, making building and houses autonomous and self-sustainable. Management systems that build the optimization of resource allocation [20] and use into an organization's processes increase their standing with external stakeholders while improving the bottom line: *Ecology is good business*.

Production as a Service. Companies can now monitor, measure, customize, and bill for asset use in great detail. They can therefore create services around what have traditionally been sold as products. That allows customers to purchase units of a service and account for them as a variable cost rather than capital investments. Consumers like this "paying only for what you use" model (per view, per song, per page) causing the great „unbundling" of products and mass customization of use. The growth of "cloud computing" (computer resources provided online through networks) exemplifies this shift. Consumer acceptance of Web-based *cloud services* for everything from e-mail to video is becoming universal. Software as a service (SaaS) and Google Apps allow bypassing capital investments in servers and software licenses. Buying transportation services by the hour rather than purchasing autos, like City CarShare and ZipCar, are also reflection of the "unbundled production." The innovation in services, where the end user is an integral part of the system, requires a different mind-set [6, 7], shifting from designing products to *designing new business models*.

The Multisided Business Model. The traditional one-on-one transactions or information exchanges are being replaced by interactions among multiple sides or parties to a transaction. This triangulation (or multiangulation) involves newspapers, magazines, and TV stations offering content to their audiences while generating a significant portion of their revenues from third parties, like advertisers. For example, *Spiceworks* offers IT-management applications to 950,000 users *at no cost*, while it collects advertising from B2B companies that want access to IT professionals. The slogan "*Free, Perfect, and Now*" is becoming a reality for many. Multisided business models are emerging in pharmaceutics, health care, financials and government. The model includes "freemium" (free of charge) and premium for special use (For example, Flickr, Pandora and Skype use such models). The greater the number of free users, the more valuable the service becomes for all customers, who can mine their "exhaust data". "What would happen if we provided our product or service free of charge?" or "What if a competitor did so?" are the new questions to be asked.

Innovation from Emerging Markets. Disruptive high-technology business models arise when technology combines with extreme market conditions, such as customer demand for very low price items, poor infrastructure, hard-to-access suppliers, and low cost curves for talent. Emerging markets are becoming thought of as wellsprings of technology-enabled innovation rather than as traditional manufacturing and assembly hubs. African *Safaricom* (M-PESA mobile-phone banking services) or Chinese *Alibaba* (B2B exchange of 30 million members, offering Chinese manufacturing capacity as a service) are good examples. The range is expanding, from a low-cost bespoke tutoring service to the remote monitoring of sophisticated air-conditioning systems. Global players must plug into the local networks of entrepreneurs, fast-growing businesses, suppliers, investors, and influencers spawning such high-technology disruptions.

Producing Public Good on a Smart Grid. Even the government is using high technology to provide more efficient, more effective and more productive services at lower cost. The use of public funds will and must be held to higher standards and stricter scrutiny than the use of private money. Technology will help to create new types of public goods, free of traditional waste, corruption and expensive bureaucracy. An urban population is projected to rise to 70 percent by 2050. Cities must be "wired" for coordination, management and automation to master traffic congestion, mass-transit systems and commuting plans. Smart water grids with embedded sensors for flows, contamination, metering and billing are crucially needed now. Also law-enforcement and educational services will benefit from cloud computing and distributed automation. Tax filing, vehicle registration, benefits administration, and employment services must be free, simple and automated. Citizens must be empowered to report, view, and discuss local problems, such as graffiti and the illegal dumping of waste, and interact with local officials on actions to solve them. Reducing, if not eliminating, bureaucracy is the goal. Novel, unfamiliar collaborations among governments, technology providers, other businesses, nongovernmental organizations, and citizens are the tools.

3D-Printing. This is a manufacturing technology that physically constructs or manifests 3D design geometry directly from 3D CAD. There are over 25 versions of this “desktop manufacturing”, like Selective Laser Sintering (SLS), Fused Deposition Modeling (FDM), etc. The technology goes also under labels of Additive Manufacturing, Rapid Prototyping, Layered Manufacturing, Additive Freeform Fabrication, and Direct Digital Manufacturing. The hardware has now become competitive with traditional manufacturing techniques in terms of price, speed, reliability, and cost, allowing also the customization of products for consumers. As the product design becomes more integrated, solid state with a minimum of parts, Additive manufacturing may ultimately complement or even replace traditional manufacturing in creating end-use products. It eliminates much of the traditional labor and can make any number of complex products simultaneously so long as the parts will fit within the build envelope of the machine [3, 12].

Vertical farming. This technology refers to cultivating plant and animal life within vertical structures like skyscrapers, towers or pyramids. Its advantages include more concentrated, localized autonomy, minimum spoilage and infestation, controlled toxicity, energy efficiency, lower cost, higher productivity, year-around crops, land recovery, natural landscape preservation, mass customized cultivation, direct community embedding, and so on [2]. Instead of open-air soil, controlled hydroponics and aeroponics technology is being used. Clearly, locally sponsored production of fish, poultry, fruit and vegetables can be sustained through subscription and community reinvestment. Combined with distributed energy generation for heating and lighting, self-sustainable “*prosumption*” communities of production and consumption would emerge.

All these and similar autonomizing technologies are complementary to the traditional approaches: their progress will be gradual and their success dependent on free market competition in investment, productivity and profitability. Only governments are sometimes trying to bypass the markets through uninformed intervention with often catastrophic results. The wisdom of governmental bureaucrats and politicians is a poor substitute for the wisdom of the markets.

4. FROM GLOBALIZATION TO RELOCALIZATION

Current high-technology innovations have certain dominant characteristics in common [18]:

1. *Reintegration.* After the centuries of specialization and division of labor, task and knowledge, we have now experienced the inefficiencies and risks of approaching the limits. The *process of reintegration* is accelerating, leading to a smaller number of workers, operations and product parts needed.
2. *Self-Service and Self-Help Empowerment.* We are witnessing the most powerful and massive form of outsourcing taking place on a global scale: the *outsourcing to customer*. Customers are increasingly performing the traditional services more effectively and more efficiently.
3. *Disintermediation.* There is an increased need for direct communication between producers (providers) and their customers, leading to the *elimination of the middle*

man. Direct access of users to information is rapidly making assorted agents, dealers and intermediaries increasingly redundant.

4. *Mass- and Self-Customization.* Proliferation of mass-produced variety is becoming unsustainable. Overloaded retail space, impaired decision making, high prices and lack of individualized customization are ushering in an era of mass customization and particularly *self-customization*: customer becomes integrated into the production and delivery processes.
5. *High-Technology Impact.* There is a wave front of new technologies with high-technology impact: qualitatively restructuring and disrupting old technology support networks and infrastructures. So called continuous improvement has spent its charge and *discontinuous improvement* of products, services and business models is now driving innovation processes.
6. *Support-Net Bypass.* Because of the (determined and fierce) resistance of technology support net owners, investors and stakeholders, equipped with money, political power and inertia of habits, new technologies have to effectively *bypass existing support nets* and create their own in parallel and autonomously by outsourcing technology support to customers and users themselves.

4.1. Reintegration of Task, Labor and Knowledge

If we take a look at the first characteristic of Reintegration, we can see that it in itself is a part of a long process spanning the history of human production. There are internal *systemic* limits to the old processes of task, labor and knowledge division. As coordination of atomized components becomes more difficult, more costly and more complex, *reintegrative processes* gather momentum:

***Reintegrating the task*:** Combine smaller process subtasks and subactivities into larger, integrated units and packages. Reduce the number of parts, components, segments and constituents comprising products and processes. This is a clear and unambiguous charge: reduce the number of parts in products and processes (fundamentally, radically and dramatically, if you wish).

***Reintegrating the labor*:** Allow workers to perform and coordinate larger rather than smaller portions of the process. Encourage multifunctionality, job rotation, despecialization and process ownership. This is a clear and unambiguous charge: let people work in autonomous teams and coordinate an integrated process rather than laboring individually on atomized and linear mass-production assembly lines. The results are bound to be fundamental, radical and dramatic.

***Reintegrating the knowledge*:** Workers must *know* (i.e., be able to coordinate successfully) larger and larger sections of the process and product, not smaller and smaller portions. Knowledge is the ability to coordinate one’s action purposefully. If one is specialized, atomized and reduced to a machine appendage, one cannot coordinate action, but only carry out single and simple commands. The charge is clear and unambiguous: the integrated rather than specialized education, training and skills acquisition – quite fundamental, radical and dramatic, by definition.

These processes (division and reintegration) cannot be characterized as a “cycle” or “wave,” or “transformation,” not even as “metamorphosis” or “growth.” The closest label seems to come from Vico’s concept of *corsi e ricorsi* in the evolution of social systems [11]. After each *corso* there follows a different and yet organically related *ricorso*. There is a course and recourse, outswing and rebound, disaggregation and reaggregation. The processes of *corso* and *ricorso* cannot be divided or taken apart. Every *corso* in human affairs is internally self-binding and self-limiting, transforming itself into its inevitable *ricorso*. Processes of the *division* of task, labor and knowledge, through their own internal dynamics and self-organization, transform spontaneously into the subsequent processes of the *reintegration* of task, labor and knowledge [14, 15].

4.2. Evolution of Economic Sectors

Reintegration is not the only long-term course-reversal-recourse evolutionary undulation. Also economic sectors evolve, due to productivity growth rate, according to so called ***S***-curve: they *emerge*, *expand*, *plateau*, *contract* and *exit* in terms of the *percentage of workforce* employed in a given sector.

So, *agriculture* has emerged and declined (as a source of employment). Today only ½ per cent of total workforce is employed in US agriculture – the most productive sector of the economy. Similarly, *manufacturing* sector had emerged, peaked and contracted. *Services* have emerged, peaked and started contracting – always due to incessant productivity growth.

A new sector has emerged: *government, welfare and unemployment*, based on taxes-financed consumption rather than added value production, sheltered from market forces, producing products and services outside market tests of "risk & return". This GWU sector, fully under political management, has already started causing difficulties: unsustainable growth, unbridled spending, high indebtedness, unbalanced budgets, corruption, rampant unionization, out-of-control incomes, arbitrary budget cuts, and, quite naturally, resistance, demonstrations and revolts spreading around like wildfires.

The evolutionary differentiation of the economy into economic sectors has reached – in the most advanced economies – the point of reversal; turning from the *corso* of differentiation and separation into the *ricorso* of unification and synthesis.

Productivity growth rates are accelerating in the services and there are no other sectors (other than (GWU) which would absorb released "let-go workforce". Mature economies find themselves at the *transforming cusp* [21].

There are only four essential activities humans can perform economically: 1. *Produce food*, 2. *Manufacture goods*, 3. *Provide services* and 4. *Do nothing*. The US economy has exhausted (from employment viewpoint) all three productive, market-based sectors. There are no other sectors waiting to come in. The GWU "sector" is based on the taxation of the other three sectors, thus unpromising and unsustainable.

4.3. Relocalization

Traditionally, relocalization has been a multifaceted activist term referring to a transformation towards communities based on the local production of food, energy and goods, perhaps even the local development of currency, governance and culture. The main goals are to enhance community autonomy, energy security, economy, environmental conditions, political institutions and social equity.

In our context, relocalization can be viewed as the *ricorso* associated with the *corso* of globalization. There is also a new label "glocalization", but that too has multiple meanings, definitions and interpretations. In our view, relocalization represents a return to the original slogan of "Think globally, act locally" which we interpret as exploiting global information and knowledge in a local action under local conditions and contexts. New economics is required to reflect the essential multidimensionality and organic nature of the challenges of customer-based relocalized economy [8, 20].

Globalization refers to a restructuring of the initially distributed and localized (albeit interacting) world economy into a spatially reorganized processes of production and consumption across national economies and political states on a global scale. In the *corso* of localization → globalization, it is the local producers and consumers who are becoming *embedded* into the structures of global economy. In the *ricorso* of globalization → relocalization, it is the global experience and knowledge that is becoming *embodied* in local communities.

It is important to realize that relocalization is not a simple return to initial localization, but a restructured, global knowledge and high-technology based expansion of the local experience. So, the corso-ricorso of socio-economic evolution is properly captured by the triad of *localization → globalization → relocalization*.

This is related to transnationalism, in the sense of a reduction in the significance of boundaries to all forms of activity, from political to cultural and economic processes. However, there is an important distinction: in globalization, national-state boundaries and autonomy are ceded upwards to supernational institutions, unions and assorted leagues; in relocalization, national-state boundaries and autonomy are distributed downwards to subnational regions, localities and communities. Either way, it is the nation-state, its traditional party-based political systems, and it's "too large to fail" inflexible giant corporations that are weakened by both globalization and relocalization. New economic and political systems are emerging, favoring small and medium enterprises (SMEs) which are better equipped to carry though the transformational change [4, 16].

With relocalization, an entire new cycle of societal *ricorso* is brought forth. Local services, local production and local agriculture, based on distributed energy generation, additive manufacturing and vertical farming, are enhancing individual, community and regional autonomy through self-service, disintermediation and mass customization. Both requisite technologies and business models necessary for relocalization are already part of our daily business and life experience.

5. Conclusions

New information technologies, especially the internet-based social and business networks, are fundamentally changing the nature of work, business and social interaction by increasing the productivity of labor also in services and governmental sectors. New technology is taking over more and more jobs on a global scale. Productivity improvement owing to technological innovation is at the point of historical takeoff. In this paper we have argued that this "technological unemployment," i.e. the inability of the economy to create jobs faster than it is losing them, is unable to compensate with new jobs in a new economic sector. Current job situation is unprecedented because all productive sectors, agriculture, manufacturing and services, have peaked in their job creation capacity, governmental sector jobs are unsustainable and no new sectors can emerge. Only transformation from globalization to relocalization, based on self-service, disintermediation and mass customization, is the new viable future for mankind.

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