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Technology and Globalisation: An Overview

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ABSTRACT *Globalisation is a term too easily used without reference to the basic enabling role of technology. It is the interplay between available technology and the prevailing social processes, especially dominant institutional forms, which has essentially determined the long process of globalisation. This process has gone through phases exhibiting varying core characteristics as production, transport and communications technologies especially have interrelated with the institutional structures of nation states, military forces and firms especially. However, a general trend to geographical and tendentially global expansion has been constant, along with an intensification of information processing and communications capacity. The role of technology has been to enable this physical expansion culminating in globalisation, including the techno-industrial capacity that increasingly drove it through the construction of better and cheaper artefacts.*

Globalisation is the buzz word of our time. Exactly what it means is disputed,[1] but pretty much everyone agrees that something is going on currently that represents a fundamental shift in the way humans live on this planet. In the myriad discussions revolving around this concept, however, it is easy to lose sight of the core issues, and one of those issues is the actual role of technology. This paper presents a brief overview of globalisation and the role of technology in this process. In the paper I argue that globalisation is a long-term trend, and although its specific character has varied, there has been a sustained project undertaken by core institutional structures to bring the whole planet into a condition under which an overall logic of social control, to meet the purposes of economic efficiency or military security, generally prevails. The particular character of this social logic has varied, being at times military–commercial, global financial, industro-militarist or cyber-financial in character. What has not varied is the trend towards increased spatial and temporal capability through the application of new technology.

And so, we ask the bare question: how important is technology to globalisation? The answer is simple: technology is essential to globalisation. Technology is the physical and organisational enabler; without appropriate technology, there would be no globalisation because it is through technology that we extend social control across the dimensions of space and time. The real question, then, is exactly how

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technology has interacted with other social processes to bring about globalisation, and that issue is the proper subject of this paper.

Technology is one of the means by which human society interacts with the material world to achieve various goals.[2] The choice of particular technological options over others is, given the basic material and knowledge base, determined by the prevailing social values and power structures.[3] In this sense, technology is never value neutral; it always promotes certain social interests over others, and more specifically, certain institutional forms over others.[4] Sustained social practices or interests are usually organised into institutional forms, such as nation states and firms, but some institutions are more basic and more equivocal in nature, such as the family and the market. The process of interaction of these and other institutions with available technology constitutes the core developmental experience of human history.

Due to the inhering ideological foundations, studies of technology development have tended to focus either on assumed socio-politically neutral market forces or patterns of national techno-industrial development.[5] The crucial role of government and especially military intervention in technological development to my mind refutes those studies which argue that technology is simply a product of economic demand, or even prescient industrial interests. As for the second position, although definite national styles can be determined in technological development (for example, US Fordist techno-industrialisation, German military techno-science in World War Two, Soviet post-war space techno-science), it is evident that the history of technological development is the history of emerging alternatives and the eventual establishment of one alternative or a combination as the core thrust through transnational competition. This competition may be either military, commercial or a combination of various forms.[6] This is to say, whatever the peculiarities of national development, the overall systemic advantages of specific technologies and associated systems eventually become clear, and those technologies and systems take on a transnational character that outweighs local variations. Historically, military competition has been very important in promoting technological convergence, and currently we are undergoing a phase of world development where commercial factors, overseen by both private institutions (mostly international securities and money markets) and public institutions (such as the IMF and World Bank), seem as relevant. Indeed, this presumed ascendancy of commercial over military experience as a paradigmatic core is a key element of the process we call globalisation.

It could be argued that globalisation really began with the global ambitions of the mid-fifteenth century Portuguese prince Henry the Navigator and the invention of the round-hulled, cannon-armed sailing ship, the most successful form of which was the carrack. This ocean-going vessel represented an unprecedented capability in concentrated firepower, logistics and commercial carrying capacity.[7] With this new technology, the otherwise relatively backward European powers conquered the world and began a phase of super-exploitation which in turn generated the capitalist and industrial revolutions which were inherently global in tendency.[8] For some time this incipient globalisation was constrained by power conflicts within the European core (especially between Britain, Spain, the Netherlands and France fighting over global hegemony) and then between elements of the core and colonial interests (most notably the wars between Britain and the US). This long conflict was eventually resolved in 1815 with the defeat of Napoleon, the clear ascendancy of Britain, the rise of sterling as a world currency, and the consolidation of the Royal Navy as a global

police force.[9] With a balance of power established to restrain European warfare, globalisation proceeded apace, actually carried out by European firms and European armed forces, and at times European missionaries. This phase of globalisation was essentially controlled at the highest level by a small strata of financier-diplomats, led by a few eminent European banking houses and statesmen.[10] These men allocated resources, ships and men by way of military orders or transfer of funds, in constant negotiation with each other through formal or informal channels.[11] Although trade and investment were the primary activities underlying this phase of imperialism and nascent globalisation, any sustained opposition to this European thrust was finally dealt with by troops and gunboats.

But for all the growing sophistication of European centred military and commercial activity, geographical distance remained a serious obstacle to systemic integration due to inadequate modes of organisational control. At the heart of this problem was the lack of suitable communications and information processing technologies. In the early 1840s, electrical telegraphy, the first viable electrical telecommunications technology, was invented. This technology transformed the way business and military strategy was carried out, and greatly accelerated the process of globalisation.[12] Commercial exploitation and colonisation, up till then seriously restricted by the problem of maintaining control at a distance, were intensified, leading to a period of heightened imperial competition after the 1870s.[13] Throughout this period shipping was transformed by the use of steam power, steel hulls and screw propulsion, which not only vastly increased carrying capacity but greatly speeded up activity as well. For the first time substantially more massive and faster ships regularly plied the world's oceans and rivers, almost regardless of natural conditions and season. Indeed, the existence of these ships, along with the necessary support systems, represented a quantum leap in transport capability that allowed ready access to virtually the whole world. Telegraphy was important to this process for both safety reasons and as a way of generating greater efficiency by regulating cargoes.[14] Shipping was at this point undoubtedly the key form of global transport, but on land steam-powered railway was also making its impact. Here, telegraphy was essential to a safe, as well as efficient, operation because trains often ran both ways on a single track, an inherently dangerous situation.[15] Shipping, rail and telegraphy were not only essential enablers, they also constituted the main business sectors of a burgeoning international economy. Shipping was perhaps the most profitable early industry of all; rail became the cause of some of the most important financial and industrial activities in the latter half of the century; and telegraphy, especially transcontinental telegraphy, was arguably the cutting edge high technology industry of its day.

This phase of globalisation itself generated a raft of social strains that led to a new phase based on different technologies and principles. Industrialisation, an inherently transnational process, transformed European, American and then Japanese society at all levels. Among its effects were the creation of strong bureaucratic nation states, the generation of sustained social dissent (such as trade unions, popular political parties and social action movements like the suffragettes) and its response, and the promotion of industrial-based militarisation in a context of growing international tension.[16] All these things when combined presented a serious challenge to the relatively crude political order of the day, and eventually resulted in a new phase of virulent nationalism, imperialism, and militarism. Industry became increasingly reorganised along nationalist lines, with national governments and banks primary organisers, albeit in differing combinations, and

the large-scale corporation, whether privately owned or an instrument of the state, became the dominant institutional form in terms of production and distribution of progressively more sophisticated material goods.

Due to all these factors—mainly industrial organisation, social unrest, and international competition—the industro-military aspects of this new world order became primary in importance, undermining the transnational, largely privately run incipient globalisation of the earlier period.[17] However, globalisation as such did not actually stop, it just took on a new form. The formal imperialism of the sort that existed after 1880, reflected in a virulent armaments race and growing international tension, placed a growing emphasis on military power. For some years, large-scale military systems, utilising the new shipping, rail and communications technologies as well as men and pack animals, spread over the globe. Such was the concentration of resources and integration of related systems that war seemed inevitable by the end of the nineteenth century, and indeed the industro-militarism eventually exploded into actual warfare in 1914.[18] It was a conflict that became effectively global in form, due largely to the existence of colonial empires, and was at base the result of issues not finally resolved until 1945 (mainly the challenge to British hegemony by Germany and the US, countries which embodied different approaches to industrial development). In terms of outright military conflict, this competition for global power had two phases: 1914–19 and 1939–45.[19]

By the turn of the century the most important industrial sector of the core nations was that concerned with building warships and cannon, the crucial weapons of the time. The industrial and scientific resources that went into these technologies were massive, easily comparable to the nuclear arms race of the post-World War Two period.[20] The great battle fleets of the belligerents in fact played a minor role in the first phase of the long global war; a phase when immature technology and conservative military thinking reduced affairs to a grim, largely static war of attrition on land, and hunt and kill submarine warfare at sea. Before World War One ended, however, the major weapons of the next and decisive phase, World War Two, had appeared; these new weapons were tanks, submarines, aircraft carriers and combat aircraft, including heavy, or strategic, bombers. To be strategically significant, however, all these new weapons had to be tactically coordinated, and this could only be effectively done through the new wireless telecommunications technology, radio.

Radio was early relevant to operational military force, especially the most mobile form, naval operations.[21] Early radio worked best over water and the large military units that warships were could house the bulky transmitter/receivers. Radio's key military advantage was, of course, that it was mobile. Early on it could not effectively compete with wired telecommunications systems, but where they could not go, or where mobility was essential, radio came into its own. In World War Two the massive concentrations of tanks (especially in the early blitzkrieg period that rewrote the manuals on land warfare), aircraft and submarines that were the strategic deciders could only operate efficiently because of the existence of functional radio.[22] Add to this the use of radar and sonar and we can see that World War Two was the time when mobile electronic sensing and communications devices came into their own as first tactical and strategic and then global control technologies.[23]

Thus, from 1914 to 1945 the process of globalisation under way for centuries in varying forms took on a very specific character. It was undertaken in the main by military units increasingly tasked with strategic goals, or by airlines and shipping

lines increasingly shaped by nationalist, militaristic needs. Factories in Europe, America, Japan and increasingly other countries as well produced vast numbers of vehicles, ships and planes that would travel all over the world shifting people and goods in unprecedented numbers. Military forces, themselves increasingly technical in character, developed the methods of organisation and control necessary to keep these mobile units operating. Consequently, vast numbers of machines and highly trained personnel were available at war's end to continue this process of global coverage in the name of national security or prestige, as well as economic profit. In short, then, it was the technologies and operating systems developed in wartime that provided the basic technological infrastructure for the next, post-war phase of globalisation.

This phase was carried out mainly by two institutional forms: one was the military, still powerful due to the central role it had played in the previous phase, especially the US military (and in particular the US Navy and US Air Force); the other was the large transnational corporation (TNC), especially US TNCs.[24] These two institutions were not as different as many supposed. Both were increasingly bureaucratic and technical in character, and they even tended to share managerial personnel.[25] Both of them were increasingly focused on the transnational and tendentially global activity of positioning people and resources around the world to achieve tactical and strategic advantage, and they had similar operational needs and problems.

As the only real victors of the long world war (with Europe, including the Soviet Union, and Japan laying in ruins or otherwise exhausted), in the post-war context the US attempted to translate its technological strengths into a global security structure.[26] Based primarily on nuclear weapons and strategic bombers, and later ballistic missiles and submarines, the US constructed a comprehensive global military infrastructure. Aside from the actual weapons, this infrastructure consisted of bases, telecommunications systems, sensing systems (especially radar), and specialised global command and control systems involving specialist personnel, computers and telecommunications systems.[27] The US went even further when it further developed the space capability originated by the Germans to create a space program, which included orbiting sensing and communications satellites.[28] This technology was inherently global in character; in fact, space satellites were not just global, they were by definition meta-global. Indeed, geo-stationary communications satellites actually work *because* they are a long way from the surface.[29] The Soviet Union developed its own military infrastructure, and even attempted to translate this capacity into non-military (that is, politico-economic) effect, but Soviet military power was never genuinely global in scope (due largely to fundamental geo-political factors) and it was always severely limited in its capacity and impact.[30] No other country could even attempt such an effort, as the precipitous techno-military decline of Britain, still a technological and economic power at war's end, showed.

The essential technological advances that enabled US technological dominance on a global scale were the development of the semiconductor and the computer.[31] The construction of computers had been greatly advanced in World War Two in response to problems related to ballistics and code-breaking. Similarly, semiconductors were also largely a result of wartime work focused on dealing with valve technology problems. In the early stages, both these crucial technologies were sponsored by the US military which provided seed funding and paid premium prices for early technology. This basic support continued right up to and beyond

the point where computers and semiconductors became commercially self-sufficient. In effect, the US effectively translated its overwhelming industro-military capability into an unprecedented high technology, commercial capability.

The early post-war years were dominated by attempts, led by the US and Britain, to reconstruct a global economy and at the same time contain communism, represented mainly by the militarily powerful USSR and peripheral nationalist liberation movements. A new international economic order, a necessary precondition for globalisation, which supposedly included all the non-communist nations, was built up under the Bretton Woods financial framework and the Marshall Plan (in Japan with less deliberate but nonetheless effective assistance from the Korean War).[32] By the end of the 1950s this process of reconstruction was pretty much complete, with the industrial nations reconstructed and economically at least able to fend for themselves.[33] By this point US companies, now increasingly transnational in character,[34] were ready to return to their expansionary strategies, stifled by the rise of nationalism after 1914 and especially in the 1930s, which arose from their mass-production orientation. Seeking new markets, these firms began to move abroad, especially into Europe.[35] This expansion of US TNCs around the globe was due to three main factors. Firstly, they were enormously productive and wealthy operations, due in no small part to the massive government directed efforts of World War Two, which had explicitly favoured corporate size.[36] Secondly, they exploited the global US military presence which provided technical systems and experienced personnel. TNC expansion really got under way in the late 1950s when the necessary technological infrastructure was in place, thanks largely to military enterprise. A transatlantic telephone line was laid in 1956 and efficient jet transport arrived with the Boeing 707 at the end of the decade (a direct result of Boeing's work on strategic bombers). Thirdly, as efficient computers came along, TNCs, as large scale organisations for whom efficient systemic management was crucial, were able to best exploit their information processing capacity.[37] As they exploited the new efficiencies provided by coordinated transnational business, TNCs transmuted the process of globalisation from one based in military activity to one increasingly commercial and corporate in character.

However, due to both the ongoing role of the US military, the Cold War itself, and the existence of international financial controls under the Bretton Woods system, national governments were still very important and most social activity was still focused at the national level.[38] From the late 1960s onwards four things changed this situation. The first was the transnationalisation of business as firms from outside the US achieved the relevant scale to effectively utilise computing power and organise transnationally. This creation of very large corporations was in actuality often sponsored by national governments which encouraged corporate concentration or explicitly created 'national champions' to take on US firms. As a result of this, there was increasingly a genuinely transnational, tendentially global corporate sector in being. The second factor was the resurgence of international and tendentially global finance. The finance sector had been hit hard by global war and global depression, but by the mid 1950s the US financial sector had recovered and, following client industrial corporations, it went substantially transnational in focus as well.[39] The third change occurred as finance markets, securities and currency exchange rapidly internationalised. This occurred in two main ways: the definitively non-national Euromarkets grew up, specifically designed to avoid national regulatory controls; and national markets aggregated to form transnational markets. Again, computing power and better telecommunications were the

basic technological enablers; financial business, consisting essentially of information, was perfect information content for such systems. The fourth factor was the rise of neo-liberal ideologies, especially in the US and UK, a trend consolidated with the elections of Prime Minister Thatcher and President Reagan.[40] In institutional terms, neo-liberalism, with its focus on removing barriers to trade, inherently favoured (trading) firms over (non-trading) states. It also embodied an inherent bias towards technological innovation as a means of achieving higher efficiency and thus profitability.[41]

By the mid–1970s convergent computing and telecommunications capacity had reached the point where effective, micro-managed transnational, tendentially global commercial operation was possible. This shift to global commerce, and a new kind of economics, was driven by two significant trends. The first was a perceived decline in nationally based economic growth, as indicated by declining business profits, but also rising unemployment and inflation. The second was a transformation in the capabilities available to firms in terms of both production and management.[42] New production technologies allowed the fragmenting of previously integrated production systems, which gave firms the opportunity to shift production to areas with low-wage, non-unionised labour forces.[43] This shift was, in fact, led by the vibrant but also somewhat volatile semiconductor industry, which was already highly automated in terms of production.[44] Overall, increasingly efficient and cheap telecommunications enabled closer managerial control of dispersed operations, while regularised jet transport and containerisation of freight brought new ways of effectively transporting personnel and goods.

At the end of the 1980s direct foreign investment, which was dominated by large TNCs, was replacing trade as the most important form of transnational economic activity.[45] Corporations, albeit mainly from the triad of the US, Europe and Japan, invested in each others' economies, and to a much lesser degree, in those of less-developed regions. The amount of wealth controlled by these firms, the ease with which they dealt with national regulation, including taxation laws, and the scope of social influence outside the purely commercial, more and more suggested that this sector of activity was becoming perhaps the most important of all in determining overall social development. The emerging fact of this increasingly pre-eminent transnational sector, along with the end of the Cold War and the growth of transnational finance markets, brought about the growing recognition that a new phase of social development, now commonly known as 'globalisation', was under way.

The 1990s saw a consolidation of these trends to globalisation. The creation of the World Trade Organisation, the ongoing influence of the International Monetary Fund, the new found activity of the United Nations, the abortive Multilateral Agreement on Investment (or MAI: even though globalisers over-reached themselves here, no one expects the essential agenda to formally establish commercial over national law to disappear soon), and the continued growth of globalisation of the corporate sector all indicate the continuation of the broad trend.[46] Technological developments continued to accelerate the process; indeed, the framework of a genuinely global transport and telecommunications infrastructure was steadily built. Airlines, faced with growing problems in relation to fuel costs and technology R&D costs, as well as environmental and competition issues, reorganised into global alliances.[47] The major international telecoms did the same, creating 'one stop' global or semi-global networks.[48] New LEO and other satellite services went into business as the satellite industry increasingly looked like a mature

sector, highly concentrated, technologically stable and focused on strategic issues.[49] Around the world, national telecoms were privatised and joined international alliances. And of course the Internet grew to real importance, presenting both new commercial opportunities and the chance of enhanced popular participation in a whole range of activities at a global level.

The ongoing transformation outlined above was paralleled by a structural shift in the way business, especially large-scale corporate business, operated.[50] During the 1980s a number of industrial control systems based on electronic telematics capability had reached new levels of maturation, causing a revolution in production processes. Business was reorganised at the office level and the factory level, based on dramatic rises in technological capacity and equally dramatic falls in costs.[51] By the start of the 1990s one of the established key technologies was electronic data interchange (EDI), a technical system directly aimed at minimising human participation within trading relationships.[52] EDI has been sponsored by the military, specifically under the US CALs scheme, and actively promoted by big business as a means of cutting transaction costs between firms. Interestingly, only a few years on, EDI was being criticised as being too slow and clumsy, the Internet being hailed as the new e-commerce core system.[53] The extension in scale and scope of wired systems has been ongoing for some time, and we have also seen a new epoch of wireless communications take form. The global spread of production and consumption, and the increasing focus on speed of operation as commercial advantage was measured in hours, then minutes, now sometimes seconds, has placed an emphasis on mobile communications.[54]

The emergence of these electronic production and trading coordination systems presents interesting questions as to the future of business structure, and especially the future of the large corporation.[55] Indeed, it is arguable that the whole rationale for the large corporation—to achieve profits through hierarchical internationalisation of market relations, and thus transaction cost savings[56]—has been undermined. All in all, it seems increasingly apparent that the central factor in the continuing trend to gigantism in corporate business is strategic market power alone, an extremely dubious practice in either economic or political terms. The eventual legal assault on AT&T, IBM and Microsoft by the US government when each company was effective monopolist in their relevant field indicates the limits to this kind of behaviour.[57] Of course, it is clear that great commercial pressure emerged to back these formal challenges as each firm became a significant technological bottleneck, and so it can be argued that commercial concentration eventually encounters limits even within a neo-liberal context. Nonetheless, it is still paradoxical that at a time of rampant neo-liberal ideology espousing free markets, corporate concentration and intra-business coordination through alliances and technical systems, which all constrain free market operations, has reached new heights. While few commentators seem ready to predict the imminent end of the large corporation, almost all focus on the need for a level of flexibility that would be very hard to achieve without radical downsizing and reorganisation.[58]

Perhaps most strikingly, the 1990s saw the rise of a cyber-financial structure which arguably came to dominate virtually all other forms of social organisation.[59] All governments, including that of the US, became seriously constrained in their activities by the actions of the global bond and stock markets, especially through their influence on interest rates and unemployment.[60] In a real sense, the fingertip control by high finance of the nineteenth century world economy had returned, in this case the main players being the super funds and the big, increasingly

concentrated merchant banks.[61] The telematics revolution was at the heart of this development too.[62] In essence, the whole global monetary system had been turned into information by the electronification of the majority of the world's money, however notional that money might actually be.[63] Securities and money markets had grown to enormous size, operated constantly, and were increasingly volatile. In effect, no nation, firm, or individual was now outside the influence of these vast flows of social information and wealth.[64]

And as in the nineteenth century, an effectively global military force backs up this cyber-financial order, in this case the US military, alone and in various alliances (most importantly NATO).[65] Despite the lack of a genuine threat, the US military continues to develop new means of projecting power on earth through new naval systems, land fighting systems and aerospace systems.[66] Also similar to its role in the late nineteenth century, the military continues its role as sponsor of new technologies, especially as the concept of cyber-war grows in popularity, through such agencies as DARPA.[67] Unlike the nineteenth century, however, this new phase of globalisation is also based on the maturation of a whole series of technologies for systemic control over production and distribution, such as robots, just-in-time systems, and EDI. As well, relations of supply and demand are carefully managed through effective use of mass media,[68] directed marketing, and the Internet. Economic restructuring has even had a basic geo-economic impact similar to the way earlier industrialisation promoted urbanisation. It is possible to argue that whole cities have become in effect global control sites, relying on cheap, high capacity telematics links and cheap air transport to maintain connection with other such 'global cities' and the economic hinterland.[69] Labour remains less mobile than during the nineteenth century when truly massive migrations occurred, but certainly the highly skilled technical and managerial classes already resemble something like a global, or at least cosmopolitan, class.[70]

In a real way, the use of the term 'globalisation' indicates what is all too often a lack of understanding of what is, after all, a social, not geographical, process. But the term is accurate in the sense that one of the key trends has been the alteration of basic spatial and temporal relationships and capabilities. Since the fifteenth century, certain social institutions have been operating according to an underlying logic which rested on the idea of continued geographical expansion to achieve power and wealth. Most important among these institutions have been nation states, military forces, and commercial firms. The exact character of globalisation, its pace and form, has varied according to historical contingency, especially in relation to the matter of which of these institutional forms has been dominant. Initially, a combined military–commercial enterprise shaped globalisation, a process later to become more highly militarised as the European core states fought each other; once this conflict was controlled through the agency of British hegemony a period of relatively unfettered commercial expansion occurred which was directed by the new international, high finance/statesman strata. As this world system reached its limits, and industry was generally reorganised on a national basis, globalisation again became militarised. In the post-war period, military primacy again eroded as commercial capability grew, and eventually this corporatised activity achieved a new level of global extent, dominated in the last few years by new forms of global finance.

At each stage of the long process of globalisation, the availability of newly developed technological capabilities played an essential role. Geographical expansion was impossible without the transport and communications technologies

to enable it, and all these depended on more and more capable industrial productive capacity, which in turn required increasingly sophisticated information processing and communications systems to enable and enhance systemic control. Thus, whatever else it might be, globalisation is a social process that absolutely depends on the availability of appropriate technology. Furthermore, in its specifics globalisation has been largely defined by the forms of technology available, and more generally by the way in which these technologies have been systemically interconnected.

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