

Crossroads

TRANSFORMATIONS ON THE ROAD TO 2040



MICHAEL LOESCHER AND MIKA AALTONEN

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OUR PHILOSOPHY

In the long catenaries of human history, there have been moments when, for one reason or another, the commonly accepted view of how the world works suddenly and shockingly is destroyed. When that common perspective is shattered, the very scaffolding of the world — its power structure, ideas of morality and legality, the tangible objects of wealth, and intangible objects of awe — collapses.

Eventually, the new world must be redefined, a new machine to hold the hopes and civilized lives of human beings must be devised.

CROSSROADS is a “blue paper”, designed to foster a common perspective on future over the next 25 years.

In writing CROSSROADS we had several specific objectives in mind:

- That the dialog be conducted across all government agencies in order to leverage talent, organization, and money.
- In particular, the recognition that national security and the national economy are linked.
- That it will lead to a structured, dynamic, analytic rigor, moving past studies and arbitrary scenarios.

CROSSROADS addresses a single fundamental question:

Can we survive the next 25 years with our present economic, diplomatic, and national security policy underpinnings?

We think that no civilization stands long that does not provide an understandable and just foundation for those that must live in it. In societies that provide such a bedrock, security and prosperity are seen as achievable goals, however distant and difficult, for most of its citizens.

There are many number of themes by which the next 25 years can be explored, but the most encompassing is the transformation in global transportation and the

implications it brings along, on which we focus in chapters WORLD TRANSPORT and EXTENDED VALUE CHAIN. These considerations are further elaborated in the DAWN IN THE NORTH before proceeding to CONCLUSIONS.

At this writing, in the winter of 2015, there is hope that the world would be reeling from financial crisis. At the top of the economic ladder, the rich are poorer. In the middle, decades of hard work of hundreds of millions of people, has been lost to a sudden financial tsunami. And at the bottom, the poor have been pushed again to the edge of a desperate dilemma. When a parent has worked all he can and still cannot feed his family, he can give only two perspectives to his children. My child, the world is unfair, but in the next you shall be rewarded. Or, my child, the world is unfair, and you must take what is yours from those that steal all that should be yours from you.

This is a dangerous precipice.

For us, the issue is certainly not preservation of any status quo, whether political, economic or societal. To the contrary, we are convinced the world is undergoing an extraordinary complex and lengthy transformation. The signs are everywhere to any who will see them. We are all going somewhere new, hence the title of our opening chapter – NEW WORLDS.

None of us, greatest or least, can plot a precise course. Nor will master plans see us through; they are the first to be jettisoned in a sea of complexity. We are all going to have to invent the new world, decision by decision, action by action, over the next several decades.

Our cooperation was founded on the common belief that the world turns on hope, that ideas are the very wings of hope, and that ideas come from hard work.

Our mission is to develop intelligence systems and networks, combined with new analytic techniques, that surface detail for decision-makers in all types of human enterprises. Finding new approaches to organizational structure and process that can transcend physical boundaries is our key goal.

Washington and Helsinki, Spring 2015

Michael Loescher and Mika Aaltonen

Chapter 1

New Worlds

DAWN

Far into the Central Pacific Ocean, there is a chain of eleven atolls that stretch for 2,350 kilometers in line, in a general direction from northwest to southeast. Not surprisingly, they are known as the Line Islands, and are part of the nation state of Kiribati. Furthest east is uninhabited Caroline Island, which is one of the world's most remote and pristine tropical islands. It lies 1,500 kilometers from the nearest permanent settlement, and still 2,700 more to Tarawa, the Kiribati capital. By international agreement, it is where dawn first comes to the planet each day.

The year 1990 began on a Monday, and as the planet revolved to bring morning slowly westward across the world, it was clear to everyone not just a new year, but a new age had begun. The previous year, the wave of revolutions in Eastern Europe, beginning with Poland and continuing to Hungary, East Germany, Bulgaria, Czechoslovakia, and finally Romania, dismantled the Warsaw Pact. In Berlin, on the evening of November 9, the first jubilant few came to the wall with sledgehammers and chisels, and for weeks afterward, more and more came. Mauerspechte — wall woodpeckers — they were called. Finally on December 22, the Brandenburg Gate was opened. A year later, Mikhail Gorbachev would be forced into resignation, and during the leadership of Boris Yeltsin, all of the state-owned wealth of the Soviet Union would flow into the hands a few oligarchs.

Six months before, in June 1989, Chinese students took to Tiananmen Square to mourn the death of Hu Yaobang, the Party General Secretary that initiated the first liberal reforms after 44 years of Maoist communism. They were the third generation, and today they are senior managers of many of China's institutions. Over the next several years working in the background, Deng Xiaoping gradually gained power, though not office, and China's new long march began. His biographers have written that Deng was greatly influenced by Lee Kuan Yew, the political genius who had lead Singapore to become the first of the Asian Tigers. In 1971 in one of his early speeches, Lee laid out his vision, saying:

“Between Japan and Europe, we must make Singapore the best place to bunker and repair ships, either in dry dock or on water. Once we have established ourselves as the ship repairing and shipbuilding center, we will remain so for a very long time. For once supremacy has been established, whether it is an airport, a harbor, or a dockyard, it is very difficult for any other place to dislodge us. For others have to compete against an established center with superior facilities, higher skills and expertise, and long-standing established customers.”

The Emperor Hirohito died, having avoided war crimes from the Second World War and lived long enough to see Japan — and the great Zaibatsu families — rise from the ashes of the war. The Tokyo Stock Exchange Nikkei 225 hit its all time high at 38,915. It had taken Japan only five years to recover its pre-war levels of output. Throughout the 1950s and 1960s the annual rate of growth of its economy was about 10 percent, while North America and Western Europe experienced 2 percent.

By 1980, Japan had outstripped, even in absolute terms, all the major industrial core countries in the production of ships, automobiles, and television sets. But by June 1990, the Nikkei had collapsed to 10,040, a 75 percent drop, ushering in Japan’s lost decade.

In Brazil, the first election in nearly 30 years was held, and voters threw off a military dictatorship that had held power for two decades. One powerful effect of the election would be that the policy of cutting down the rainforest to create farms would come to an end. In South Africa, the end was in site for decades of apartheid unraveled with the election of F. W. De Klerk.

In Europe, the collapse of the Warsaw Pact resulted in a mass migration of people from the east to the west. The world got its first look beyond the wall, and the depth of the communist failure became clear in the paucity of infrastructure. The Maastricht Treaty remained two years away.

In 1990, there were 5.3 billion people in the world — 2 billion had been added since 1970. Of the 1990 population, 60 percent worldwide lived in rural areas.

“Mobile” phones existed, but were a large, awkward and expensive — \$4,000 in the US — and since the only networks were analog networks, they rarely worked anyway. GSM cellular telephones would be invented in the following year in Finland. “Long distance” telephone calls could derail a family budget. Cable and satellite news was in infancy. In Russia, the only radio and television was physically wired to homes and had but one channel. The only telephone connectivity for most of the country was provided by high-frequency radio repeaters along the Trans-Siberian railbed. In China, Central Asia and Africa, telephony was virtually nonexistent. All communications worldwide

were conducted by imposing variations on electromagnetic waves: “digital” information transfer was unknown. GPS satellites were just being launched but they were a Top Secret project of the US military. Satellite imagery of the type we are accustomed to with Google maps was the deepest secret of all in NATO and in the Soviet Union.

The nature of work was very different. Worldwide for most people, a day’s work could usually be measured in some way: a kilometer of track was laid, thirty widgets were machined, five letters were typed, eight sales calls made. For the public, the internet did not exist, and a domain was still part of a monarch’s realm. There was no web, no email, no search engines, electronic commerce or social networking. Personal computers were rudimentary, if an exciting development, but without Microsoft Office and browsers to a worldwide web that had not yet emerged, there wasn’t much to do with them, even for enthusiasts that could afford them. Typewriters and teleprinters were the means by which the world’s writers worked.

Cigarette smoking was still ubiquitous, and cigarettes constituted one of the world’s largest export products. Steel was a small industry, regionally located. Rare earth elements were rarely used. Transnational companies had come onto the scene, but what made them really explode later — access to cheap labor and foreign direct investment were yet part of the economic fabric.

Most of all, the world in 1990 was no longer living in the long shadow of war that had begun in August 1914, and it was seen so at the time. All of the underlayment of the colonial age was now gone, at long last. The empires of Britain, France, Germany, Belgium, Russia, Japan, and the US were all gone, as were any notions they might rise again. Unions and socialism were gone. The world’s most powerful leaders in 1990 were all products of the rolling consequences of the First World War. They grew up in the Depression that war directly caused, and lived through the horrendous extension of it from 1939 to 1945. The Bretton Woods system was a reflection of determination such a war would never happen again, and so to were the institutions it created. The business of the world was war and peace.

By the end of 1990, all of these leaders and the world they created, had begun to part the world stage. The next generation of leaders, not only had a different view, but much of world leadership, for the first time since Medieval Europe, lay outside of government. The business of the world, for them, was business. In the main, world government came to agree.

Twenty-five years later, that generation of leaders are retiring now, and all over the world, a new generation of 40-year olds are moving into their places and carry burdens of trying to make the world a better place. They are the focus of this work, whether in government or non-government organizations.

The financial collapse of 2008 has brought a long pause, if not a redirection, of world society. So deep and disruptive was that crash that it rivals any in past history. Certainly no other, including the crash of 1929, so suddenly brought crisis to the entire world or to a world so large. Everywhere there is a struggle about what to call it. No one wants to use the “D” word, and we won’t quibble. There is little doubt, however, that the blind faith in the marketplace and market forces, which so characterized the last generation of decision-makers, who inscribed its mantra on so many briefing slides, one-page memos, and wiring diagrams, has had cataclysmic consequences, which in the end only government intervention forestalled.

Globalization, as we have experienced it in 25 short years, has vastly increased the fragility of the world economy, moved much of the world’s economic activity beyond the reach of either sovereign or international law, and brought the planet’s climatological and ecological systems to the brink of collapse. It did not have to be so. But just as the Great Depression unleashed the dogs of war, so too did 1990 unleash the dogs of commerce. It will be the job of this generation to deal with that economic violence.

We hasten to clarify. These same two and half decades have brought into the world truly powerful and extraordinary tools — some them so powerful they might just get the planet out of some of its most difficult dilemmas. These would not have been invented absent a marketplace that could reward its inventors. The last 25 years have unleashed human creativity on a scale that makes Gutenberg’s printing press trivial. One of the greatest and most hopeful points of light on the horizon is the ability of the internet to leverage creativity. Of the 7 billions on earth today, millions — perhaps tens of millions — are geniuses.

The next generation of leaders will be presented with the most difficult problems any human generation has had to face, and some of them will be unprecedented in all of human history. The institutions of government have been weakened, and the men and women who move into government will have the task of creating better and more effective government in the face of public disillusion, while nonetheless running into the especially short time lines of environmental collapse and population increases.

Sociologically and demographically, the world in 2040 will have almost no resemblance to that of 1990, and this generation of leaders will have to make that passage. Politically and economically, the world is not globalizing, but rather it is coalescing around three great regions, each of which faces very different problems and all of which may find different futures. The period from 1990 to 2015 has all the markings of a temporary passage rather than arrival at some more permanent destination unto itself.

ELEMENTAL CHANGE

When the dawn arose over Caroline Island on New Year's Day in 2015, there were abroad in the world a number of new developments that had no historical precedent. Change in this world happens so fast we have to pinch ourselves to be reminded just how fast. Human civilization is in its 7th millennium. It's tempting to imagine that each new generation has viewed its time as more complicated, more sophisticated, than previous generations. Tempting, but it doesn't hold up.

For nearly all of the human experience as we understand it today, stasis was the hallmark. There are caves in China that were continuously occupied for tens of thousands of years. In New Mexico, in the Western US, there is an extraordinary pile of rubble that is testament to the slow, unchangeable pace of life, preserved as the Salina Pueblo Missions National Monument. It would fit within a football pitch. For 800 years, day in, day out, month in, month out, year after year — 40 generations — the inhabitants trudged down the mesa to a stream to get water and trudged back.

Change, when it did come, could be sudden, often catastrophic, and generally permanent. The most common historical form is invasion: here the Scythian, Hyksos, Assyrian, Persian, Macedonian, Han, Roman, Hun, Aztec, Norseman, Mongol, Arab, Spaniard, slave ship, American frontiersman, Briton, Frank, Belgian, German and more have all had their day, with the affect of one of two choices: be assimilated or be decimated. Pandemics, which are a function of time, distance, and previous exposure, followed, as often did a new enforced religion.

From time to time, the planet revolted to bring change: drought with attendant famine, earthquakes and volcanic eruption, have all brought sudden change. Often as not, these were behind invasion.

Less frequently, new inventions opened doors to a new social structure, slamming shut the previous. Here the list is long as invasion — for man the predator and man the toolmaker they are one and the same: agriculture, metallurgy, weaponry, writing and accounting, money, shipping, banking, navigation, communications and transport, energy sources, and more. Yet all of these, including new technology, impacted the unhappy lot for one or two generations before things settled down to some new norm, during which those surviving individuals live once again settled to watch the grass grow.

In the last 100 years, and especially in the last 25 years, change is omnipresent, as much a part of the world as the land and seas. *Dynamic, gut-wrenching, cascading, unpredictable, relentless change, oscillating within the catenaries of technology, trade, creating harmonic waves and spinoff events, is now the norm.* This kind of change is new: psychologically, physiologically, and sociologically. The dynamism of the world gives us no respite, and it is accelerating.

VIRTUALITY AND VENUES

There is the rise of the alternate reality we call virtuality. *It is one thing to shape the environment with tools. It's another to create an environment as a tool.* Like Alice, we have fallen through a mirror to a wonderland. In that remarkable place that is no place at all, in the virtual world, all the elements of human nature are played out as well, creating another place to be, one overflowing with frightful danger and nearly boundless opportunity. As happens with euphoria, at least for the moment, we are addicted to it.

Cyberspace, for lack of a better term, is only one of virtuality's manifestations. Virtuality is not just information, with it we make tools to operate across cyberspace moving in and out of physical space. Leeuwenhoek and Galileo could observe beyond human sensors, but we can create operational venues transcendent of our sensors. A surgeon in London, working on a precision model of a patient's heart in Tokyo, can move the instruments from half a world away. This is very new, very profound, and we are just beginning. The more we sense, the more we will be able to do.

THE PLANETARY CRISIS

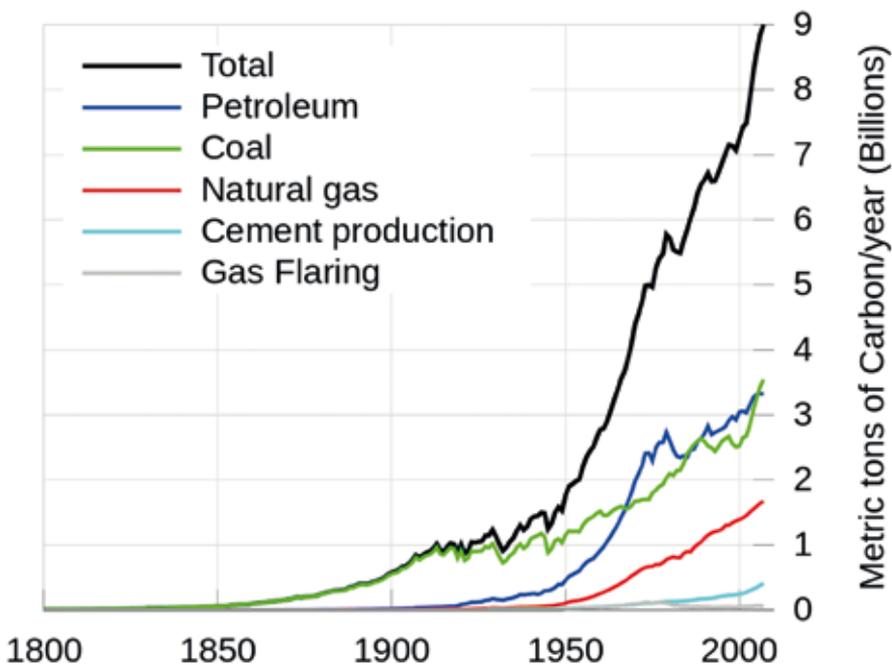


Figure 1. Global Carbon Emissions from 1800 to 2000.

There is imminent exhaustion of the biome. The environment is in a steep state of decline, such that no strategic planner in any type of enterprise worldwide can afford to dismiss it. Moreover, across every ecological niche worldwide, there are simultaneous collapses of horizontal, vertical and temporal relationships. This is new.

While global warming has captured much of the concern, it is unfolding on timelines that are largely unknown, and the root cause of it, which is fossil fuels and aerosols are not going to be diminished. To the contrary, the discovery of cost-effective technologies for extraction of crude from oil sands and oil shale, as well new reserves in both natural gas and oil, are likely to increase emissions. Estimates are that emissions are likely to increase by as much as 50 percent by mid-century. Moreover, long-term emissions data show that substantial increases began just after the end of World War II, and it is impossible to know at this point whether the tipping point for atmospheric warming has been reached or whether the processes in place can be rolled back.

Government decision-making is the art of pragmatism. Absent some breakthrough in energy technology that supplant fossil fuels worldwide, and quickly, climate change will proceed. In any case, it clearly will proceed for the next 25 years at least, which is the time horizon for this generation of leaders to take action. Yet much can be done, and soon, it will be too late.

In this regard, *it is sobering to consider that the present globalized economy involves steaming basic commodities and intermediate materials back and forth across the world, often multiple times, for the sake of capturing the lowest possible labor.* China's rise has been fueled by steel production from more than 2,500 small and largely antiquated steel mills, which burn coal for energy, coking coal in the production process, and in no small part, depends on the environmentally bizarre transit of Brazilian iron ore halfway across the world to Qingdao. Dry bulk carriage of coal and iron ore is now almost 40 percent of worldwide shipping.

Globalization, with the attendant industrialization of the least developed and developing nations, is both the root cause and the fundamental multiplier of atmospheric degradation. Were it not for globalization, the number of point sources for emissions would diminish sharply and perhaps present a reasonable opportunity to apply stack scrubbing and other interim technologies until alternate sources of energy might be found. Moreover, the substitution of new materials for steel would turn the dynamics of world trade and world pollution around virtually overnight. So too would photosynthetic films in cities. The untapped dynamic in climate change is the other side of the equilibrium balance: the world desperately needs oxygen in the atmosphere, which can be increased dramatically in a very short period.

Sustainability is an economic term that has no environmental meaning at

present. *The environment is in a very steep decline, especially in food chain destruction, soil depletion, water contamination, and above all photosynthetic production.* In the name of biosynthetic fuels, Borneo has been deforested. To export cotton, the Aral Sea has dried up. To produce beef and pork and chickens, soybeans, cottonseed, and corn have to be grown, requiring large tracts of photosynthetically productive land to be cleared. All of this is directly related to export economies, which has been the hallmark of world trade since the Bretton Woods system was inaugurated, and since 1990, globalization has made absolute. So long as commodities and energy are at the base of global value chains, those chains subtract environmental value.

POPULATION GROWTH

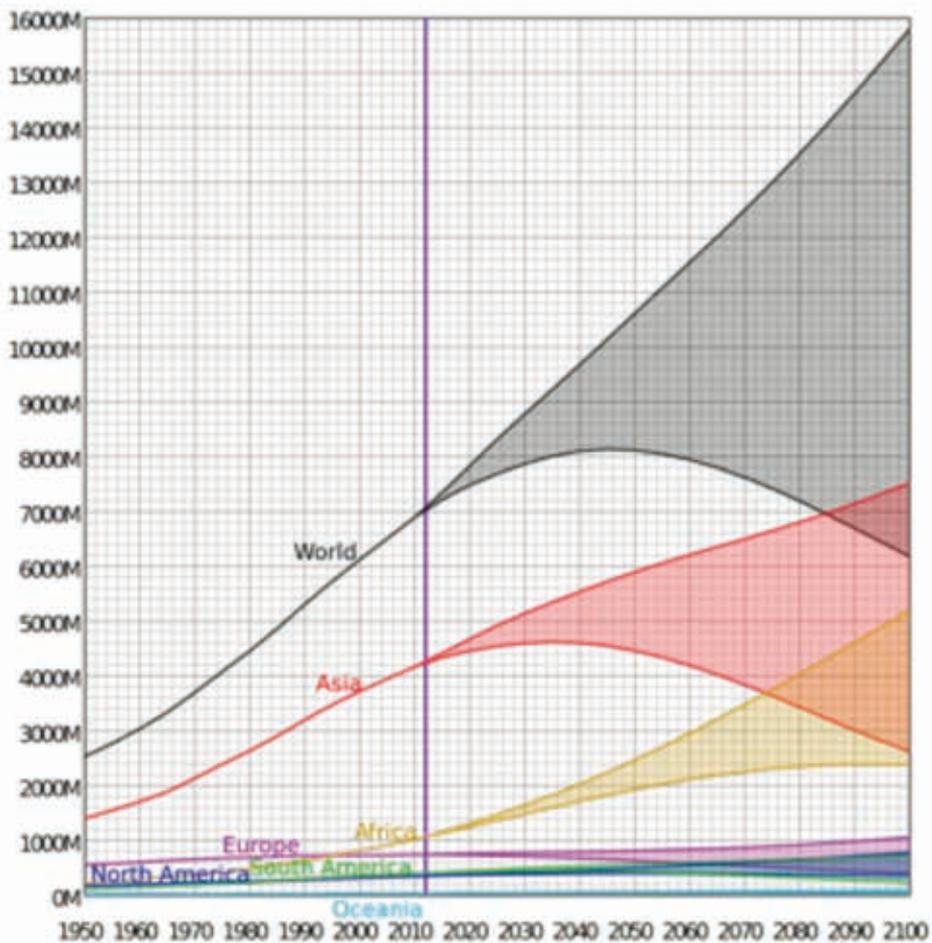


Figure 2. Global Population from 1950 to 2100.

Among the critical change factors there is also the growth in human population, which has multiple implications. *What is fundamentally different than ever before in the history of life on earth is the composite effect of an instantaneous (in geological timeframes) explosion in the human population and the ubiquity of the population across all the ecosystems of the planet.* Sudden explosions in population are not uncommon in nature. Planktonic blooms and bacteria and viral infections are two common examples, both of which occur with far more suddenness than the 200 years it has taken humans to increase from 1 billion in 1800 to 7 billion, give or take, today. There are also many instances of very widespread distribution across ecosystems, which is what invasive species are all about. But there are no known instances in which nearly the entire planet – its water, air, climate; nearly all of its ecosystems; and all of flora and fauna at large have come under instantaneous and simultaneous assault.

From an environmental perspective, there is no question that the degradation of planet's biosphere has been caused by our species, which is predatory, invasive, omnivorous, exceptionally adaptive, and relentless on the hunt. In these characteristics, we are hardly alone among species. We are no less a product nor a participant of the biodynamics of the world than the rest of the many predators that inhabit it. Life in nature really is Hobbesian: brutish, violent and short. If seal pups could talk, they would not mourn aloud for the fate of polar bears.

It has been clear for several decades that the genus *Homo* evolved about 2,5 million years ago as a distinct branch from earlier hominid groups in the line of great apes. The fossil record outside of Africa shows multiple migrations occurred across all of the continents in a succession of distinct species of the genus. The last migration, being our own, seems to about 135 thousand years ago. For a long time, the puzzle has been the cause of the migrations. It is now generally believed that the ongoing cyclic series of ice ages resulted in drought on the African savannas, which added to the decline of large mammals already hunted so successfully by humans.

By 40 thousand years ago *Homo sapiens* was in Europe, Borneo, Australia and New Guinea; by 30 thousand years ago, it had reached Southwest Australia, Tasmania, and Okinawa; and by 15 thousand years ago, crossed the Bering Land Bridge, and rapidly spread throughout both Americas to the southern tip of Patagonia.

All along the way, lock step in succession with the spread of humans, large bodied animals vanished to extinction. In Australia, nearly all large creatures disappeared: giant kangaroos, rhino-like and leopard-like marsupials, a 400-pound flightless birds similar to ostriches, and large reptiles such as 1-ton lizards, giant pythons, and land-dwelling crocodiles. In the Americas, horses, lions, cheetahs, leopards, camels, enormous bison and giant ground sloths, musk oxen, mastodons and three types of mammoths died off abruptly.

Nor, as all know today, has the hunt stopped. In the Tsukiji district outside of Tokyo, where the world's largest fish market stretches over an area the size of 43 football fields, a single blue fin tuna weighing 222 kilograms fetched a price of Euro 1,3 million in 2013.

Seen this way, environmental degradation has been ongoing since our species became successful. *What is important about this is that as our population has spread across the globe, we have destroyed ecosystems and eco-relationships that have taken far longer to evolve than we. This, when placed alongside climate change, means that the earth cannot be "restored." It is going someplace new.*

Global human population growth is around 75 million annually, or 1,1 percent per year. The global population has grown from 1 billion in 1800 to 7 billion in 2012. It is expected to keep growing to reach 10 billion by the end of the century.

The actual annual growth in the number of humans fell from its peak of 88 million in 1989, to a low of 73,9 million in 2003, after which it rose again to 75,2 million in 2006. Since then, annual growth has declined, and is projected to fall steadily to about 41 million per annum in 2050, at which time the population will have increased to about 9,2 billion.

URBANIZATION

Globalization, and maritime trade, which enables it, has created world in which no country is any longer self-sustaining. This is not an irreversible trend, as we will explore in subsequent chapters, but it is the situation today. Simultaneous with that trend, sometime in 2008, the human species crossed the threshold toward becoming a different animal: an urban creature, geographically divorced from the natural world that still continues to feed and fuel us. *Now, for the first time ever, we have more people living in cities than out on the land. Also, for the first time, most of us have no substantive ability to feed or water ourselves. We have become reliant upon technology, trade, and commerce to carry out these most primitive of functions.*

The world's rural population is projected to peak somewhere around 3,5 billion in 2019; then gradually fall to around 2,8 billion by 2050. Most of this rural depopulation will happen in the developing world, because the OECD countries have now largely completed this shift. The reason for this migration is that they can make money in town. There is no demand anywhere in the world for farm labor.

In China, this is one of the great dilemmas its leaders face, having opened up the Pandora's Box of industrialization on its eastern coast. In 2011, Chinese census recorded it now has more people living in urban areas than in the country. The speed of that migration is remarkable and provides a clear measure of the

impact of globalization in that country. During the first three decades of Maoist rule, the rural population declined less than 9 percent from 80 percent in 1949. Income for city dwellers in China is more than triple that of rural residents, and by government standards, the disposable income was twice that in cities than in the country.

It is also a migration that speaks volumes about the misery of Chinese rural life that a culture rooted in land for thousands of years and so tied to an ancestral tradition, is running, not walking, to cities, where quality of life from overcrowding and pollution is so low by outside standards. One reason is that China's misery in the last 100 years has no equal. While the first televisions were arriving in the West, the most conservative estimates are that 35 million died of starvation between 1958 and 1962. China lost 20 million people World War II, second only to the USSR's 24 million casualties. Four other famines, from 1920 to 1943 are said to have claimed 10 million more. Floods and earthquakes took more millions of lives. The 1918 influenza epidemic took more than 50 million lives.

Worldwide, urban centers are shifting east. Of the eight new megacities anticipated over the next fifteen years, five are in Asia, two in Africa, and just one in Europe. No new megacities are anticipated for the Americas.

In 1950, only two cities in the world had populations over 10 million: New York and Tokyo, and much of Tokyo's size is attributable to migration after war. From just two in 1950 and three in 1975, megacities number nineteen by 2007, and projects put the number at twenty-seven by 2025. In that year, for every one hundred children born, fifty-seven will open their eyes in Asia and twenty-two in Africa, and mostly in cities.

Several implications are relevant to our discussions here. There is the irony that humans that have spread across the earth, and who have long relished zoos, will be on the outside looking in after 2025. This may mean that opportunities to remedy environmental degradation may increase, both from new urban technologies, as well as relieving the burdens of human occupation in the country. This effect could be very profound, ushering in an entirely new type of economic marketplace, and certainly we can expect new products will emerge from the demand to make cities more livable. Revenues will increase, as jobs increase.

Most profound, with respect to world trade and transport, it points to a world increasingly regionalized. In a world of megacities, growing alongside the new economies of India and the Far East, it is difficult to find compelling arguments for those regions to buy goods and services from developed nations. To believe that the present patterns in world trade will continue is to deny the progress the Far Eastern developing nations have made.

DEVELOPMENTS IN TRADE

So often do we use terms “globalization” and the “global economy” that it is easy to forget what misleading generalizations they can be. What we mean, generally, by these terms is that trade today is both international and interlinked.

Trade has nearly always been international, or at least across conducted across long distances. Anthropologists have many examples to offer us going as far back paleolithic times of valuables of one kind or another that originated on one continent and ended up on another via human exchange. It is the “interlinked” part that is different. *In one generation and without much warning, the world has assembled itself with true complexity into the unlikely linkages we have come to call global value chains:*

1. Among the most obvious changes since 1990 is the necessity for nations to trade. After the past 25 years, there are very few non-trading nations in the world. Those that remain are largely poor, backward, socially, politically and economically isolated, and more often than not, landlocked. They count among their number failed regimes, and nations that lack natural resources, industrial development, internal transport infrastructure, and good government. Even de facto criminal states such as Afghanistan, or sub-areas of nations, such as the drug-dominated areas of Mexico, Columbia, and Thailand, rely on global trade to create the large hoards of cash they generate. Until our times, trade has been largely opportunistic, never obligatory on any large scale. That is no longer so.
2. Only 25 years ago most of the world lived behind the walls of communism, and almost completely isolated from world commerce. Outside those walls, consumer goods had two principal sectors: automobiles and a fledgling selection of electronics, such as cameras, televisions, and music devices. As a result, by far, Atlantic trade dominated Pacific trade.
3. The rise of the Far Eastern economies has created a third great region of commerce on the planet in addition to the Americas and Europe. Though for the last 10 years China has been the most discussed, Korea and Japan collectively are the world’s great industrial cauldrons in machinery, automobiles, and ships. Along with Taiwan, they hold a significant share of global information technology and electronics production. Singapore has become a global finance center and one of the world’s great ports astride what is arguably the world’s most important strait.
4. The migration of the global economy to transnational corporations, which

began slowly after the close of the Second World War, accelerated sharply after 1990 and is now nearly complete. *This is a trend with multiple implications. For one, it has led to the aggregation of much of the world's most valuable commodities in the hands of a very few corporations. It has also minimized the analytic value of national economic statistics.* Nokia was no more a Finnish company than Apple is an American company. Import-export figures are largely meaningless — much of the movement in goods in and out of borders is reflective of trade between different elements of the transnational subsidiaries. Transnational incorporation has effectively created a new group of actors in world society, which lie outside and largely operate beyond the world's legal frameworks.

5. Under the aegis of global value chains, labor has become commoditized, with the net effect that laborers no longer have bargaining power nearly anywhere in the world, not are labor conditions regulated.
6. The arrival of information technology has migrated the mechanisms of market finance from national to extra-national banking and, as a parallel development, enabled futures derivatives and other financial instruments that are largely unregulated to dominate the world's financial activities.
7. The nature of trade also has changed. From the 16th century to the close of World War II, trade was largely one way. By any measure, the first era of globalization was less about trade than theft: profits generally flowed to Europe westward from the Far East from spice, tea, and textile trades. What economic trappings arose in the process were afterthoughts, organizational and financial tools, to deal with the plunder. Absent the sword, gunpowder, and not a small amount of opium, there would have been no profits. It takes a finely trained macroeconomic mind to see it any other way, given the hindsight 400 years provides us. That era is past.
8. In its place is a different flow of goods, one in which the transit of commodities and intermediate goods flows back and forth across the earth in the development of finished manufactures. The geographic direction, volume and value of today's trade flows are determined from highly volatile, rapidly swinging from side to side, extrinsic factors, such as time-to-market; capital flows; insurance and reinsurance; complex, often opaque, often traunched, global ownership; and, above all, the cost of logistics, both supply and demand. Ultimately, global value chains turn on devalued labor, which is, in effect, what is being transported back and forth across the seas in modern maritime trade.

9. Finally, what is produced has also changed. The world economy is a consumer-driven global economy, with the result that the value of manufactured goods has a high level of volatility, oscillating rapidly amid the temporal abstractions of comparative innovation cycles, disruptive technologies, consumer disposable income, and the perception of value that comes with fad and brand.

All of these developments were made possible by open world of global transport, and none were features of the world economy a generation ago. The great question is whether such a system, having developed in a single generation, based on consumer-driven global economy in which perceived value of manufactured goods has a similar volatility that comes with fad and brand, and which oscillates rapidly amid the temporal abstractions of comparative innovation cycles, disruptive technologies, and consumer disposable income, will remain the model for the future.

Chapter 2

World Transport

Transport is the great intersection between virtual and physical worlds. There are limits to what can be done in either world. It is transport that shuttles us between them, making the leverage of the virtual world tangible in the physical.

By 2015, it is becoming possible to see that different modes of transport, overlaid with the operational discipline of logistics, may come together as a fabric that has a sophisticated enough warp and weave to truly connect world trade in a system of systems. The world is a considerable distance from this at the moment, but there are strategic pressures and voltages that are discernible on the horizon. These, coupled with the melting of the ice caps, may bring the first real shifts in the geography of transport since the last Ice Age. Future polar circumnavigation itself is only a part of a larger transformation in world transportation.

Today, however, while we may think of the world economy as global, and generalize its workings in macroeconomic terms such as global value chains, world transport is far more heterogeneous. As with trade itself, global transport is lingering on uncertain divide between the aftermath of the world economic crisis of 2008 and whatever comes next. There are clear signs of significant change, across all the modes of transport: air, land and sea.

AIR TRANSPORT

Airfreight transport, with its low-volume, high-rate profit model, is concentrated on manufactures, both finished and intermediate goods, rather than delivery of raw materials. Worldwide, it is the smallest of the four transport modalities, in volume, weight and in value carried. We have chosen to exclude a detailed discussion of it from the work, because it is principally a driver in the far upstream of global value chains, and occupies therefore strategically a niche role in world transport overall.

Air transport plays different roles in logistics chains in different parts of the globe. In the US and Europe, airfreight is a highly integrated component of an overall intermodal infrastructure. Moreover, relatively short Atlantic flight times, and the large number of good airports facilitates its use between the continents for high-value, small weight goods. It is growing in importance in China as that country extends its inland port system, but is much less used in Japan (where high-speed rail is extensive) and in South Korea, where distance among production centers and internal markets is negligible. In South America, Australia and Oceania, and Africa airfreight fills gaps in transport that elsewhere might be served by more extensive road and rail.

The world's largest airfreight carrier is FedEx Express, which handles the world's highest volume in terms of airfreight flown and has the largest dedicated fleet of almost 700 aircraft. It is the fourth-largest aircraft fleet in the world, using feeder aircraft to and from small and mid-size airports and the huge Airbus A300s and Boeing 777s freight-configured for long-haul routes. It operates from a "super hub" in Memphis, Tennessee. Second behind FedEx, UPS Airlines operates a more than 500 aircraft, headquartered from its hub in Louisville, Kentucky. A distant third in terms of size, with 75 aircraft, DHL Aviation is the leader in European airfreight. In descending order of market share, the remaining top 10 world air freight firms are: Cathay Pacific Cargo, 22 aircraft; Korean Air Cargo, 24; Lufthansa Cargo, 18; China Airlines Cargo, 19; Singapore Airlines Cargo, 13; Emirates SkyCargo, 10; and Cargolux (Luxembourg), 14.

FedEx and UPS have approached airfreight from different directions, and both have been highly successful, if competitive. Whereas FedEx is focused primarily on airfreight, UPS has an extensive truck-based ground-freight infrastructure providing door-to-door throughout the Americas.

HINTERLAND RAIL

Landward, transport systems are not distributed evenly, or even remotely so, across continents or regions. There is such a large imbalance in worldwide rail freight infrastructure that it is possible to identify genuinely vast land areas of the world as transport "deserts" in which access by rail into the hinterlands or even across continents is either lacking or inadequate to support economically significant transit. Landward, much of the world is landlocked, railway construction has not provided new routes since its beds were surveyed 150 years ago. A statistical case in point is instructive. About 25 percent of world trade, by value, occurs between countries that share a land border. But that statistic, while true, offers little insight

into the state of trade in the world because the number reflects the robustness of land-based infrastructure in North America, and the special relationship between the US and Canada.

There are several especially important missing links worldwide, each of which represents both obstacles to expansion of international trade by land, and also different and critical political and strategic dilemmas for neighboring countries:

1. The first of these missing links is in the Americas, where freight rail infrastructure on the northern continent is the best in the world, but north-south rail connects to South-America are interrupted just south of the Panama Canal at the Darién Gap. It is an undeveloped swampland and forest between Panama and Colombia just over 160 kilometers long and about 50 kilometers wide. Darién is the gap for both rail and the Pan-American Highway, which proceed further into South America along the Pacific coasts south to Valparaiso, Chile and thence eastward across the Andes via two lines to Brazil and Argentina and Uruguay. Consequently, there is no land route connecting North America with South America. The Americas speak a common language, collectively contain two of the largest agricultural areas of the world and vast amounts of commodities, especially of energy, and are home to a large potential reservoir of cheap labor and middle-class consumers. Linked with robust intermodal transport in the future, the Americas would become both powerful exporters and self-sufficient importers — an enormously disruptive development to our present construct of globalization.

2. Second, in Europe, though passenger rail is among the best in the world, freight rail connection is highly problematic in a variety of directions. From the North Sea ports inland overcrowding the norm on both rail and roadways. East-west railway was improving, but once passage extends into the former Warsaw Pact nations, modernity drops off sharply. North-south freight rail is even more problematic, a topic we shall return to in subsequent chapters. From the Nordic countries to the Mediterranean it is completely lacking, and east of the old Iron Curtain, both passenger and freight rail, and road infrastructure, are minimal and antiquated. This has an important strategic effect of isolating both large areas within the EU, and the EU from Eastern Europe and Eurasia. It also isolates the great ports of the North Sea from acting as points of economic entry beyond the Ruhr and Saar. More problematic, any European rail improvement eastward and southeastward stops at Russia, which is the largest transport “desert” in the world. Despite considerable marketing efforts to the contrary, Russia’s

rail and roadways are rudimentary at best and limited in location to the underbelly of the country, which follows the old Tsarist Trans-Siberian route, as does the social, civil, and industrial infrastructure of the entire country. The implications of this are significant not only for the EU and Russia itself, but also for China.

3. In most of Africa all infrastructure is rudimentary, but road and rail are virtually non-existent in any sense of transcontinental or even interregional transport.
4. The routes across Central Asia are poised to open a passage of immense strategic importance, and in our view, along with the transpolar routes, the most disruptive development in transport.

Elsewhere in the world, freight rail and freight trucking are far less intense, and in Eurasia, rudimentary where present and largely absent elsewhere. Those nations and regions that have access to the sea have linkages of some kind, however limited, to the world markets. Those that are landlocked pay a heavy price, and where landlocked and without sophisticated road and rail, are backwaters.

MARITIME TRANSPORT

Little in this world is made or traded that does not move by ship the seas, and often, manufactured goods cross the world several times before they are finished. Both of these facts are new. Until the Second World War, only Britain and Japan were dependent on shipping for national survival. And until 1990, most of the goods produced in the world remained on the continents on which they were made. *Never in history have we dug up the earth in one place, shipped it around the world to another, and back around again and again an integral part of the industrial process.*

Alien beings off the planet, and certainly future historians, will have to shake their heads in wonder of the armadas of our time: ever greater Leviathans that lumber across the globe back and forth — not for tin or gold or spices, but to capture the cheapest labor on the planet, at the cost of great economic fragility, geopolitical risk and considerable complexity.

Far upstream in the global value chain we speak so frequently of these days, iron ore from Brazil is gouged from the beneath the Amazon jungles and shipped to China. High quality coal from the Bowen Basin in Australia or from Tavan Tolgoi in Mongolia is shipped China as well to make coking coal. There, they are used

to steel in China's more than 2500 largely antiquated mills that Beijing openly worries about reforming. But the mills are controlled by regional governments, and quotas are set locally. Bad loans from the mills, excess steel and even more excess iron ore is piling up, while China still must import high-quality steel from Japan and South Korea.

The steel is used to build a special class of ships — 400,000 tons deadweight, each costing of \$110 million to build. These are steamed back across three oceans to Brazil, where they will reduce the cost of shipping even more iron ore back and forth again. Yet, as they are being built, the ore company that ordered them, Vale SA, a Brazil-owned sovereign company, incorporated for foreign business in the Caymans Islands, lost more than 75 percent of its value as iron prices has fallen precipitously. Nonetheless, Vale is ramping up its iron ore production, because doing so drops the price more, and it hopes to use the recession to drive its competitors out of business once and for all.

Oil tankers carry crude to China from all over the world to fuel its shipyards and factories. State-owned Sinopec, is the 5th largest company by revenue in the world. On average Sinopec receives on average one VLCC (very large crude carrier) every day at its Huangdao terminal just across from Qingdao, where iron ore is landed. By pipeline, the crude arrives at Dongying, which acts as a hub, parceling out crude to Sinopec's many refineries in the Shandong province, especially Cangzhou, which receives about 80 percent. Meanwhile, both the price of crude and the price of oil tankers is dropping sharply from the North America's sudden bonanza in crude from oil shale and oil sands reverses a 50-year trend in the US imports of oil, sending the tanker business spiraling down as well. When that happens, the oldest tankers are sent to die in India and Bangladesh, where they are cut to scrap by labors with torches and hammers making less than Euro a day.

Meanwhile, high-quality steel produced by ArcelorMittal or Nippon Steel & Sumitomo Metal Corporation is used by German, Swiss, or Japanese textile-machine makers, which ship machines to all the textile factories, including China. China also makes the textile machinery, but like much of its steel, they are of such low quality Chinese factories seek machines elsewhere, including used French machines bought when factories there were put out of business lower labor rates in the Far East.

Cotton bales for the textile come from Texas, where they are grown with such deep government subsidies that no other nation can compete. The 2014 US Farm Bill, long considered the largest single piece of Congressional “pork” (lobbying) bill, is a strange piece of legislation, which costs nearly a trillion dollars. It mixes benefits that mostly go to the poor (food subsidies) with other subsidies that mostly go to the rich (crop subsidies for large farms). A provision for crop insurance pays insurance companies \$1.45 for every dollar paid to farmers. As a penalty for

keeping cotton subsidies in place, the World Trade Organization's rules require the American government to pay \$147million a year to compensate farmers in Brazil.

Texas cotton grows from boutique seed, made and patented by Monsanto Corporation to resist the company's own pesticide. Fully 70 percent of the world's cotton is grown with Monsanto's seed now, and the company sells the seed only for one crop — farmers cannot recover seed from the bolls. How would Monsanto know if you stashed some seed? It has its own army of police that come to each field, that's how.

Cotton is picked from the fields in Texas with high-tech machinery, made in Michigan or Japan, and taken in bales to a local cotton gin, where the seed is separated from the fiber. Cottonseed oil has endless lucrative uses. It is a major commodity in itself and is shipped to a hundred different factories by rail and sea, while the cotton fiber goes to a hundred more. From Texas, the Union Pacific Railroad, carries it in containers that are lifted onto ships at Long Beach and carried westward to the Orient.

The Texas cotton rolls just north of Haiti, Guatemala, and Honduras, all three among the poorest countries in the world and all three overflowing with textile workers. But they compete with workers from China, Vietnam, and Bangladesh, and generally lose. From the Texas cotton fields in Lubbock to the US port at Long Beach, California by train is 1,700 kilometers and takes one day, and by sea a non-stop route from Long Beach to China Terminal in Bangladesh is 17,000 kilometers and takes 27 days. From Lubbock to the Port of New Orleans by train is 1,300 kilometers and takes less than a day, and by sea to Honduras is 1,600 kilometers and takes less than three days.

All of these are precursors to a sweater and the machinery and energy needed to make it. Each travel by separate voyages across the world in ore carriers, tankers and container ships, which are the three major ship segments of the shipping industry. Each of the ships will be owned by different companies, nearly all incorporated offshore in places like the Cayman Islands, where anonymity is guaranteed by law, so that protection from liability assured. Their owners may or may not be their operators: ships are often chartered to other companies, which also will have complex corporate entities. Each ship will be registered in yet another place, like Liberia, though the ships may never make landfall there. Liberian ships are registered for Liberia by an US company just outside Washington.

At the end of the day, all of this occurs because labor is cheaper outside of the developed world. Global value chains depend on devalued labor, and ships make that possible.

PERSPECTIVES ON SHIPPING

No enterprise on earth, or in history, has ever been as important to the world as the shipping industry is today. Farmers everywhere depend on shipping; nearly everywhere in the world the land now is too poor to support crops without fertilizer. The poorest people on the planet, who live in the Congo, depend on it. Glencore Corporation — a monument to greed and corruption of such magnitude it rivals the great stone faces on Easter Island — has come own much of the mineral wealth of Congo, and it depends on it to haul the riches away. Singapore thrives, and Sri Lanka and Subic Bay in the Philippines do too, yet none have intrinsic wealth nor will last long if trade patterns shift.

Even landlocked countries are impacted by maritime trade, and in those countries the importance of shipping is fully evident by the paucity of it. Landlocked nations, especially those that have poor infrastructure in road and rail or lack connections to countries that do, are isolated from commerce and tend to be backward not only economically, but politically and socially as a result. Shipping a standard container from Baltimore to the Ivory Coast costs about \$3,000, while sending that same container to the landlocked Central African Republic costs \$13,000.

Vast areas of the world exist in this condition — more than realized, perhaps, at first glance. Where these deserts exist, crime and corruption flourish. Much of Central Asia, once the Silk Route of trade falls this category — all of the six so-called “Stan’s”— are governed as cults of personality, or as in the case of Afghanistan, ruled by the warlords of the heroin trade.

Everything and everyone goes down to the sea in ships nowadays, and that is new. So new, it was not so in the past generation. Never before has the all world depended on maritime trade. Only history books speak of maritime and continental nations now; shipping is a rising tide that floats all boats. Yet, only 100 years ago, Britain went to war when an envious and neurotic Kaiser refused to remain a land power and began building a fleet too.

Yet despite its great importance, few enterprises on earth, or in all of history, have ever been so opaque. Few human activities have been beyond the reach of the law — even monarchs and dictators had borders. Not so with shipping companies, which are incorporated and reincorporated, and held by other corporations, in layers like nested Russian dolls. With the dolls, the nest comes to a last layer. But with shipping, if one walks the dog backwards long enough, the trail leads nowhere.

Offshore havens like the British Virgin Islands have laws against revealing ownership, and more than 800,000 corporations worldwide count on it. Included among them are the trusts and private corporations of no less than fifteen of China’s richest, members of the National People’s Congress and executives of its huge state-controlled companies.

The transfer of a single cargo of containers can involve hundreds of individuals and corporations all along the extended shipping chain. The chain of ship and cargo ownership may be very deep, with ports and terminal operations even deeper, and investment chains deeper yet. Insurers are reinsured, and owners increasingly are investors in exchange-traded hedge funds, far beyond the reach of financial oversight.

Most of all, the core activities of the shipping industry have become financialized. Freight derivatives in some segments at times have had more invested in them than real freight in transit.

Like the world economy at large, maritime trade is balanced on what appears more and more to be a tipping point. The last 25 years of globalized trade brought about great change in what is shipped, how it is shipped, and where it is shipped. From 2004 to 2008, in four short years, the shipping industry experienced one of its greatest booms and deepest busts in generations. Seven years on, still there are no clear signs of stabilization in shipping, though the industry routinely announces the crisis is over. It is not.

Each of its three main sectors, dry-bulk carriers, which haul commodities around the world; crude and refined tankers, which distribute the world's liquid energy; and container shipping, which carry its intermediate and manufactured goods, are in a state of flux and extreme financial risk. Great issues are now at stake, both for the industry and for the world, which now depends utterly on maritime trade for the conduct of nearly all commerce.

To see those stakes, one must look from two very different perspectives of shipping, which together span both the narrowest and widest views maritime trade. We begin our discussion with a brief sketch of both.

Financial Perspective

At narrow end, one perspective is focused on the shipping industry as a strictly commercial enterprise and homes in exclusively on its financial aspects. This is view, a very real and powerful perspective, from the boardrooms of the world's largest shipbrokers and analysts, financial investors, marine insurers and from a set of large commercial shipping firms whose business it is to charter ships.

It is a perspective with a tidy, highly structured, story line in which shipping is a business played by a group of legitimate actors, which are corporations. The risks associated with shipping are seen as strictly financial, and they are borne by the corporations. Such risks arise from the rise and fall of supply and demand of freight capacity on world routes. They can be mitigated through hedging and futures techniques, which act to smooth out oscillations caused by short-term concerns. Further, by creating additional alternatives to acquiring ships beyond the capital layout of direct ownership, the risks of investment can be mitigated. All

this is possible because what goes around, comes around: the shipping business is cyclic, and all this activity takes place four markets: the freight market, shipbuilding, the market for sales and purchase of ships, and shipbreaking.

In recent years, it has come to be the dominant view of shipping, particularly in Europe, where the financial markets of shipping were invented and are now concentrated, and, until recently, where the largest shipping companies in the world were located.

It is a systemically myopic view for several reasons, not the least of which is that much shipping activity lies outside the narrow confines of the financial markets, and many shipping companies, both great and small, do not participate in these markets. Like the financial world at large, it is a perspective akin to summarizing the world economic activity as confined to commodities and stock exchanges — as though shadow banking, offshore banking, non-public corporation transactions, private bonds, trade in kind, and remittances from the world’s expatriated poor and drug trade, bribes and kickbacks, sovereign fund manipulations, somehow do not exist.

Moreover, the financial-market perspective has a number of serious blind spots. It is a perspective of futures markets, applied to the shipping industry. Like nearly all futures markets, the entire underpinning of the financial-market perspective of shipping is that it rests on a deeply ingrained belief in the certainty of cycles, specifically shipping cycles. “Shipping cycle” is an unfortunate term. What is really meant by the term is that freight rates are cyclical.

Since the Baltic Exchange was established in 1744, when they entered the shipping industry in full force, shipbrokers have been driving shipping in that direction. If there were no shipping cycle — if what goes around doesn’t come around again, and within short enough cycles to provide market rhythm — there would be no basis for a futures speculation.

As a result, there is a marked tendency to ignore or be blind to developments that either are not financial in nature or are not of short-term impact. More simply put, the managers and employees that work in these markets are uniformly focused on the time horizons stipulated by the financial instruments in futures markets — to the exclusion of all other, non-financial trends or those that lie outside the time horizon. This creates a self-reinforcing tide that lowers all boats.

This is further exacerbated by several other factors, including the relatively small numbers of analysts in the industry, the dominance of a few large shipbroking firms, the inherent difficulty in validating data from distant points around the world, and, above all, the fact that in a marketplace that reacts immediately to all news, bad news is rarely forthcoming and good news always suspect.

More people come to work each day at Disneyland Paris than in the shipping markets. Yet the European Investment Bank’s portfolio of transportation sector

loans, nearly all of them in the maritime sector, exceeds 10 billion €, 23 percent of the total. These sums, of course, are exclusive of the debt held by other banks. Nor is the European Union the only government exposed, as we explore further below.

In this light, it is instructive to understand the limits of freight indices. Behind its famous facade, the Baltic Dry Index, which is used worldwide as a measure of freight rates, is compiled by phone bank of twenty employees who daily call other selected companies as the sole input for the index. This would be of little concern if the information was limited in impact to those who participate in the markets, but it is not.

Worldwide, the media, academia, and NGOs like the UN, World Bank and IMF, rely almost completely on the shipbrokers and analysts that work in the financial markets as their primary source of data. It is difficult to find any study on world shipping, including the influential flagship publication put out by UNCTAD annually, that does not reiterate the views and statistics provided by Clarkson, Lloyd's Drewry, and IHS Fairplay. More importantly, in those regions where shipping knowledge has become largely vested in commercial companies, the financial-market perspective has become influential beyond the value of its analysis, particularly for government decision-makers. Thus, the financial-market perspective of shipping has reach considerable reach, and its blind spots multiply in their consequences.

There is also the inherent fault in logic of the market suppositions to consider, which is that the key elements of world trade will look tomorrow much like it did today. Not only does that supposition rest on shaky analytic logic, it has no basis in the experience of the past 25 years, during which both shipping and world trade both have been turned upside down and inside out. *Most of what is traded today, by value or by tonnage, did not exist 25 years ago. The same logic runs directly counter to the experience of the past 100 years, during which shipping collapsed into one its darkest periods in history. For a time, the seas were almost barren of ships. The flow of goods at sea — the trade routes of the world — have changed fundamentally three times in the past 100 years in response to political developments, not economic swings or shipping cycles.*

The financial perspective also confuses economics with business. The supply and demand for freight, which is what is really meant by the term shipping cycle, can only be cyclical if shipping routes and cargos remain constant over statistically meaningful periods of time. This has not been the case, either in the past 25 years or in the past 100 years. In dry bulk shipping, this truth leaps from the headlines almost every day.

The tanker business has not been stable since the Middle East plummeted into chaos in the 1950 forcing supertanker construction, and rerouting Suez Canal around the African capes. Today, US crude exports for the first time in 60 years.

Large scale production of crude from oil sands and oil shale, the continuing

Iran oil embargo, the depletion of North Sea and Saudi and Kuwaiti oil reserves, the general migration of refineries away from production fields, the discovery of large Arctic oil reserves readily accessible of Alaska, Canada and Greenland, the development of Central Asian pipelines are all game-changers in progress.

The entire trend in globalization has been to move manufacturing to the Far East, where the requisite skill levels for assembly of goods has been cheaper, than in Europe and the Americas.

Very little is intrinsically cyclical in shipping, save that the futures-oriented financial markets require it to be so.

The great problem with shipping is that the enormous capital outlays required both for ships and infrastructure, as well as the expertise and tradition of expertise needed to conduct maritime trade – which are not trivial matters – makes it, in fact, anti-cyclical. Shipping business itself is not cyclical, but spiral, and the overall vector of that spiral has been downward since the end of the Second World War.

Since 1990, the cumulative effects of the upward legs of the cycle have not lead to long-term improvements in the shipping infrastructure worldwide. They have been concentrated on the China trade. The downward legs, however, have accumulated in effect and have impacted the future of the industry significantly. Across the shipping cycles, from World War II to today, four long-term trends stand out clearly:

- A largely irreversible eduction in the number of shipping companies worldwide.
- A trend toward fewer, newer, larger and more specialized ships.
- A near-complete decoupling of ships and shipping sovereign and international law, through the mechanisms of transnational incorporation, offshore banking, and flags of convenience.
- A high level of fragility in routes and rates stemming from rapidly shifting supply chains, especially in commodities and intermediate manufacturing.

Two other great shortcomings require discussion here before moving past the financial-market perspective.

The first of these is that the shipping business is not the realm of overt actors, but rather it is replete with invisible elephants and corporate chameleons. One could read any of the thousands of pages on shipping markets, or texts on shipping economics, or wander about in the jingo of value chains for days and miss the overarching trend since the end of the Second World War – the demise national merchant marines and nationally associated shipping lines to less than twenty large transnational corporations that control it today.

Many of them are disguised: effectively nation-state merchant marines in the

guise of shipping companies. Behind them are the invisible elephants of government power. This certainly the case of China's ships, which are all state-controlled, and well on their way to becoming the largest fleets in the world. It is also true of United Arab Shipping Company (UASC), which is owned by six of the Arab states of the Persian Gulf: Bahrain, Iraq, Kuwait, Qatar, Saudi Arabia, and the UAE. One consequence, which we explore below in greater detail, has been that Marseilles-based CMA-CGM, which absorbed all of France's nationalized shipping lines in a series of controversial politically influenced moves, has now been forced of financial necessity into an alliance with China's state-owned lines and the UASC.

The remainder, including every one of the top 10 shipping companies in the world, is incorporated directly or indirectly under favorable legal frameworks in obscure nations. Many have deep connections to sovereign funds.

The second great shortcoming in the financial perspective is that it reflects the idea that market forces are the drivers in maritime trade. The idea of four distinct shipping markets, evolving and jostling against market forces, in a world of free markets is not only short-sided and myopic, it is worse than wrong: it is a delusion of mythical proportions. Shipping does not take place in a tidy world in which nation states, envisioned along western lines, and responsible corporations respond to market forces.

World reality is quite different, as Europe's three largest merchant shippers Maersk, MSC and CMA-CGM learned when their attempt to form of the consolidated P3 Network, collapsed in ruins in June 2014. Making the rounds, the proposed allies sought permission to operate in the world's ports, approval of which would have given them as much as half of the world's container ship freight market. The EU said yes. So too did North America. But China said no, seeing the opportunity to drive its only foreign competitors permanently onto the rocks.

The P3 group was publicly shocked, and its efforts to scramble afterward point to considerable private shock as well. Shipbrokers were positively atwitter at the development. Journalists wrote copiously on the topic, as did academic. Maersk, the largest, saw the light, and cast off the French partner CMA-CGM to the wolves. Bleeding billions, the family-controlled Danish firm closed its European yards — including the 100-year old Odense yard opened by great grand-pere Mærsk-Møller, and gave new shipping contracts China. China then approved the next alliance with only MSC as a partner.

Yet the shocking part was their surprise, and it is proof-positive of the blinders the shipping industry has come to wear. Surely one of the great ironies of modern times, and less than 125 years after the last dying gasp of Imperial China, hostage to European, Japanese and American treaty ports, China's decision is wholly consistent with its actions across the past 25 years. If that were not sufficient lesson, the Brazilian ore giant Vale got another at Chinese hands when its largest

new ore carrier was not allowed to enter Chinese ports. It too saw the light and gave large contracts to China's state-owned yards.

Chinese merchant shipping is now the largest in the world with the South China Sea and Indian Ocean poised to hold the largest markets in the world, whilst American shipping is virtually non-existent and Europe's shipping on the ropes. What goes around comes around, but its not the shipping cycle that causes it.

Not one of today's shipping companies arose or has been primarily sustained from markets forces. Everything opposite is true. Shipping companies are dying off, despite one of the greatest explosions in world trade since the Portuguese rounded Africa. The top ten container shipping companies are a product of overt government investment, except perhaps Mediterranean Shipping Company (MSC), which is privately owned, headquartered in Switzerland and is meticulously anonymous. Yet MSC's rise in no small part is due to its associations with Greek and Italian shipping families and is only sustained by mantle of Swiss law. Maersk has been saved by its oil exploration grants from the Danish government, and CMA CGM not saved at all.

The same is true of shipyards, which are vital industrial base for trading regions. Commercial shipbuilding is now almost completely resident in China, South Korea and, as a distant third, in Japan. In each country, however, market forces, and certainly not the shipping market, had little to do with their development. Shipyards have been the product of heavy government funding and the means for reconstruction after the Second World War.

Naval shipbuilding, the other division, which relies on technical skills rather than labor, has also dwindled, everywhere but in the US, where naval expenditures are increasing in response to a Chinese naval buildup. China is a long way from the technical skill base necessary to build naval vessels; it is still struggling with quality in commercial shipping. But there is no doubt from its ongoing efforts that China sees the importance of a navy — it is rapidly building the first in its history, and deficient skills will be mastered in due time if it continues its resolve. Meanwhile, British naval yards are closing, and Russian naval shipyards, never of comparative quality, have fallen into an advanced state of decline.

Both major canals are sovereign-owned, though Panama has given a 50-year *carte blanche* operating contract to a state-owned Chinese corporation, which came in fourth in international bidding, but somehow won the contract.

Singapore is the world's largest transshipment port, due only in part to geography: government subsidies and favorable tax laws have made it attractive. Right behind it is Malaysia.

China is now home to the world's largest container ports, dry-bulk ports, and the world's busiest ports by every measure from traffic to value of goods and gross tonnage. All of these are the direct result of government investment. There are

no non-state controlled shipping companies in China, nor shipyards, nor major components of the maritime industrial base.

The list of top ten container ports in the world no longer has Rotterdam (now 11th), Hamburg (14th), or Antwerp (15th) on it. Ten of the top 20 ports are Chinese, two are Malaysian, and one each is in the US and UAE. Of these, only the US port complex at Long-Beach/Los Angeles is not the direct recipient of government funds.

There is scarcely a greater myth in the world today than the notion that shipping and maritime trade are the product of market forces. Nor one more dangerous to the EU.

Perspective Of Maritime Trade

A larger, more inclusive, and long-understood perspective of shipping is that it is the very physical and very concrete enabler of world trade — not of the economy as an abstraction, or the financial markets, or as part of a concept of logistics — but rather the intensely practical means of getting things hither and yon across the globe. Precisely where hither and yon might be, and what kind of cargo is carried between them, has varied greatly over the millennia. From time to time, there have long periods in which maritime trade vanished.

What has also varied is the importance of maritime trade to those that conduct it. For nearly all of history, shipping has been critical only to a few nations. For the rest, there was opportunity. For the few, it was life and death. This fact of it has been recognized since shipping began.

For this reason did the Doges of Venice lend to its merchants, Isabella fund Columbus, Phillip II build men of war, Elizabeth give Drake letters of marque. For this reason were the East and West India companies authorized and the crown colonies and dominions flagged and defended. For this reason, did Britain, the US, and Japan build navies. It is why Japan went to war, and why China is building its first navy today, and why the US is escalating its naval expenditures. *While it is possible to conduct maritime trade on a small scale without the leverage of diplomatic, economic and naval instruments, it is not possible for nations that depend on maritime trade as a lifeline to do so.*

Until the turn of the 20th century, the world at large depended on nothing from distant regions. Oil changed that. The Bretton Woods institutions fueled the addiction to exports. After 1990, when then phenomena we know as globalization emerged, did the world need shipping. Since that time, all of the world's nations, realize it or not, have become maritime nations.

Any commercial perspective, financial or not, therefore, is fixated only one niche in an enterprise of much greater geopolitical magnitude.

The financial markets in today's shipping industry are the production of invention, a fact that makes them no less real, but also no less exclusive in their perspective.

The core nature of maritime trade, however, is not cyclic nor very rhythmic at all. To the contrary, maritime trade is not a constant in history, but rather arises and collapses according to the viability of three distinct conditions.

Conditions of Maritime Trade

Going to sea and trading at sea are different matters. Humans have been taking to sea for a very long time. Just how long is a matter of considerable debate among archeologists. One set of evidence can be seen in a collection of 6,000-year old petroglyphs found in Finnmark in 1972, which included a number of small boats with distinct prows. More recently, a painted disc showing an advanced ship with a sail was found in Kuwait, dated perhaps 1,500 years earlier, which would place less sophisticated vessels presumably much farther in the past.

In the Pacific, the archeological evidence of the settlement of Melanesia suggests that open-ocean sailing has a much more distant past, certainly at 10,000 years ago, and some archeologists suggest the migration of early man to Australia, some 45,000 years ago, occurred by way of dugout canoe.

Maritime trade, on the other hand, is a relatively new development, and one we take for granted. Traders used small boats shortly after the great agricultural settlements in ancient Mesopotamia, but the archeological evidence points to their use largely as merely conveyance — a sort of waterborne camel.

Moving cargo profitably and systematically around the world is a far more complex and sophisticated undertaking than just putting out to sea. That kind of enterprise does not begin until 1,500 BCE with the Aegean Bronze Age powers, who pieced together the all fundamental elements of shipping that we would recognize today: money and credit, large purpose-built freighters accompanied by naval vessels to protect them, transshipment hubs in the form of colonies, and even regular scheduled “liner” service.

Why shipping took so long to emerge is instructive because the reasons for its emergence are enduring.

Both Phoenicia on the coast of the Levant, and the Minoans, centered on Crete, developed great and rival merchant systems. Crete has been continuously inhabited for at least 120,000 years, and Neolithic farming began very early, perhaps by 7,000 BCE. By 2,000 BCE, Crete was the center of a great Aegean Bronze Age shipping empire with a diaspora throughout the European shores of the Mediterranean. To the south, along the Levant, the famous Phoenicians emerged as rivals and spread along the African shores.

Neither case seems to be a gradual development. Though littoral trading had been ongoing, the shipping empires were not the culmination of an evolved system across thousands of years, at least in the same sense as collectivized agriculture or

chariot-based military forces. Phoenician shipping, in fact, springs almost whole cloth from the archeological record about 1,500 BCE and follows immediately after the development of a league of about ten cities along the coast of modern Syria and Israel.

Despite its sudden appearance, it was not the result of a sudden invention or discovery. No wheel, plow, coinage, advancement in navigation, or any other specific innovation immediately precedes it. What then, caused the formation of these two great shipping empires?

In a word, profit. More specifically, three convergent conditions arose for the first time in history as a tipping point, that made deep sea trading possible, and they have been the consistent prerequisites for maritime trade ever since.

Enduring conditions for maritime trade:

1. The first is met when extraordinary profits can be made from distant trade, which can be reached only by, or far more efficiently by ships. Maritime trade is never about modest returns because ships and infrastructure are huge capital expenses that are not risked lightly. Throughout history, extraordinary profits realized by shipping have come from the exchange of commodities when they can be bought on the cheap and sold dearly on return. The margin of profit between buying cheap and selling dear is increased, and risk decreased, when monopolies can be created. The Phoenicians accomplished this on both legs of their voyages. Outbound, they carried their precious purple dye known as Tyrian purple, made from the glands of carnivorous sea snails, and used, among other things, for royal clothing. The dye was greatly prized in antiquity because the color did not fade, but actually became brighter with weathering and sunlight. In this, they had a monopoly. On the return voyages, from Iberia and Britain, they brought back the most valuable commodity of the time – high quality tin, lacking in arsenic, which added to copper made it possible to pour bronze into moulds, created the weapons for which the age is now known.

2. A second condition exists when profits can be realized merely from the transport of the commodities, which means demand for them must be very high – a related but different attribute than profit. In a strictly landward market, supply and demand may set price, but shipping has a number of underlying time components that impose friction on that smooth landlubberly generalization. The primary oscillation is amortization: ships have to be paid for while the market is hot; they plummet in value when it is not. A harmonic oscillation is voyage time: time at sea is dead time.

The longer the route, the fewer cycles of profit. To make money, ships need to be in constant transport, dumping cargos quickly to get more. This condition reflects an underlying unidimensional obsession found the maritime trades: high risk, the necessity for quick returns to service that risk, and the overall complexity of inherent in going to sea, added to the dead time associate with transit, all conspire to make maritime shipping an intermediary economy. Shipping is art of the middle-man, and middle-men are everywhere in the shipping industry. In the Aegean Bronze age, this condition was met through the establishment of distant colonies. Neither the Minoans nor the Phoenicians transited long trade routes in a single leg. The state of the art of ships and navigation required staying in site of land. Long voyages, even if possible, increased the dead time at sea and the risk of storms and, most important, raiders. Moreover, the geography of the Mediterranean held treacherous waters for heavy-laden ships under oar, especially the swift currents at the entrance to the Dardanelles, where in ancient times, Troy thrived in the Black Sea trade.

3. This leads to the third condition, which is that for shipping to arise and stay viable, the world must be both stable and secure for shipping. Economic is paramount: men do not go down ships without high confidence they will make money and a lot of it. When an economy is in flux, it is better to sell shoes. This need makes the rise of shipping lag the rise overall economic upswings. Success and the human proclivity for greed creates an inertia that makes selling off ships before a downturn the act of a rare genius. Thus, the shipping business is like the children's story of the little engine that could: slowly, slowly does it built speed up the mountain and suddenly does it plummet down the other side.

There is another implication to stability, which is the need for naval protection. Lumbering merchantmen, whether at 5 knots under oar, 5 knots under or, 10 knots under sail or 15 knots under diesel, cannot defend themselves. Nor, without naval power, whether explicit or implicit, can merchant ships be assured of strategic passages or access to ports. The case for this is visible in our time in the rapid rise of the Chinese navy and the corresponding increase in the US, UK and Australian naval expenditures, which has very nearly reached the level of modern arms race.

These conditions are most conspicuous in their absence. The idea of shipping cycles and of shipping general as an enduring feature on the landscape of human society is contrived at best. The world has gone through long periods in which these conditions were lost, and shipping died. Even longer periods can be seen as necessary for it to arise again. Like trade itself, maritime shipping is not necessarily

constant feature of human history. Seaborne trade arises from an open world in which people, ideas, and fungible merchandise all move about. When human society suddenly contracts, trade does as well, and shipping is the first casualty.

Bronze Age shipping died exactly so. Suddenly and violently, within 50 years, one of the most sophisticated cultures the world has ever produced was utterly gone. Between 1,200 and 1,150 BC, all of the major cities in that world one by one were destroyed, from Crete and mainland Greece around the Aegean Sea deep into Anatolia and finally to Egypt.

Why the destruction occurred is a matter of continuing controversy. Just before the collapse, in 1,274 BCE, the Hittites, whose empire was centered in Anatolia, invaded the Levant, where they fought a ferocious battle with the Egyptian Pharaoh Ramses II who met them at Kadesh in modern Israel. Military scholars warfare have long viewed Kadesh as the first truly great land battle in history involving certainly 5,000 chariots and perhaps more, as well as 200,000 foot soldiers. The battle was a draw, and the two kingdoms signed a peace treaty. One theory for the collapse is that, as happened in the Thirty Years' War in Europe 3000 years later, vast numbers of mercenary bands would be freed to roam and pillage. References to marauding bands of nautical raiders, referred to as the "sea peoples" by the Egyptians, begin just after the battle.

Simultaneous with the collapse, one of the world's most violent volcanos — Hekla, on Iceland — exploded with a stupendous eruption, throwing huge amount of volcanic ash into the atmosphere. From core sediment samples and pollen residues across Europe, the Middle East and North America points to significant climate change for at least 20 year, during which time prolonged drought began and famine surely followed. Whatever the causes, the end was not prolonged for either the age or the shipping empires that created its great wealth. No longer was there wealth; no longer could ships go to sea safely; and no longer would tin be needed to make bronze. When the dark age that followed finally ended, the new armies that slowly emerged wielded iron.

THE MAJOR DIVISIONS IN SHIPPING

There is ample literature available on shipping, and here our intentions are limited to a discussion that is useful for decision-makers whose problems intersect with maritime trade, but are not part of the business. There is a level in all complicated matters a boundary of concepts below which further generalization subtracts from understanding rather than adds to it.

There is also a level of detail that has to be mastered to gain understanding,

above which little understanding is gained. Shipping is no different. It has deep historical roots and a persistent jargon that is more confusing than helpful. The taxonomy of ship types alone, most of them hangovers of days before container-ships, is enough to confuse. In the following sections, we seek the most efficient approach to understanding the shipping industry with sufficient detail to see emergent and divergent trends.

LOGISTICS VS MARITIME TRANSPORT

There is first, the matter of logistics and maritime shipping, which are very different. On some plane, logistics has been central to the shipping industry since the late 1800s; in that need lies the origins of groups like the famous Baltic Exchange. But the modern use of the term, of course, arises only in the past fifteen years as modern communications and data handling has spread sufficiently to overlay a service level atop all forms of freight transit, sea, land, and air. Few topics in commerce have generated more breathless presentations, articles, wiring diagrams, and theoretical diagrams than logistics.

Yet, logistics is practice very nearly anti-conceptual. The essential dynamic is the acquisition, mastery, and if possible, the monopoly of local detail — ask anyone who works in the business. Successful logisticians deal in powerpoint; they make their living because they have very deep knowledge of specific distant and highly variable local infrastructures, and very successful practitioner are wont to share it. Ultimately, their business turns on rolodexes and the time and distance variables of freight rates. Salesmen over the world have understood since time began: it isn't what you know, but who you know.

Not all forms of logistics are viable, despite the apparent need. In our own lives most of us have come to understand the truth of this, or come to quickly, in the matter of passenger travel. Travel agents have gone the way of horses and carriages and not because there isn't a need, nor because the industry wants to cut costs, though the initial bloodletting began with that and a period of mass extinction has occurred. We're just not willing to pay the cost of having a middle-man pave the way for our travel. The internet paved the way for the transition of the airlines from a service segment to a futures commodities segment.

Conceptually, in business plans, and on value-added diagrams, the economic benefits of internet purchase of airplane tickets to one place looks a lot like another. Many of us will buy a two-week all-inclusive vacation tour online to Paris, Madeira or Orlando. A brave few initiated in the world might buy one online to Zambia, Bangladesh or New Guinea, but we doubt many do it twice. Humans live with tiny airline seats — unless they are wealthy, profligate, or lucky enough to expense

them for business — because the cost of airline tickets has soared in the past 20 years. Carrying passengers is nowhere on earth a profitable enterprise, plane, train or bus. All over the world, passenger transport is either government-subsidized in one-way or another or non-existent.

No one cares, even ourselves if the price is right, if humans get anywhere on time in the travel business. Carrying passengers is nowhere on earth a profitable enterprise — plane, train or bus. All over the world, passenger transport is either government-subsidized in one way or another or non-existent. Service has become unnecessary. Not so with freight, however, which pays — and fabulously — on the right route at the right time. But unlike the passenger business, service is becoming a key differentiator, an integral part of the freight business. Everyone in the freight chain — shippers, insurers, middlemen, factories, retail outlets — all care about getting parts just in time.

Logistics, then, is an upside-down business: details matter. They validate and drive new concepts.

Maritime transport, on the other hand, is multidimensional and difficult to capture in a linear fashion whether one attempts it from the top down or from the bottom up.

A detailed knowledge of one dimension in shipping does not necessarily lead to a better understanding in another. On the other hand, a conceptual understanding of one perspective is largely exclusive of the broader bedrock. The business of transporting fertilizer from Canada is different than iron ore from Brazil, and both are different business than operating a string of small tankers in the Baltic Sea. The impact of freight rates on one route may or may not impact another. The impact of a prolonged depression in shipping may be very grave in one region, while in another, much less so. For example, a very large amount of trade in North America occurs between Canada and the US and is impacted only very little by problems in the container shipping business.

Moreover, *maritime trade has the additional complexity arising from its multiple dualities — the chameleon-like nature by which a shipping company may be sovereign-owned, but incorporated, and typically in a different nation-state and still flagged in another. There is too the issue of invisible elephants: those anonymous owners and operators, which have such a great impact, both on the industry and in the geopolitical dimension of maritime trade. It is a sort of schizophrenic business, with multiple realities, which like the quantum physics of atoms will not reduce each to one or the other.*

One must then move up and down from concept to detail and side to side in shipping. In many areas, concepts can take us pretty far before detail matters. Understanding how to tie a bowline isn't necessary to know how container shipping works, nor must one know how to write the algorithms for freight derivatives hedging to see its limits. On the other hand, lacking a certain level of operational

detail in shipping, however, it is easy to spin a globe and come to completely erroneous conclusions. As an example, take the often-cited notion that a small-scale backward port like Murmansk will grow ultimately to become the western terminus of a future international Northern Sea Route. While it may play well into Russian marketing, it is a spectacularly uninformed notion.

Depth in shipping matters especially in three areas:

1. Mastery of geography is mandatory. Without it, nothing can be understood in shipping. Shipping is carried out in the physical world, and the planet's geography is very diverse. To speak of trends in shipping, therefore, in composite terms such as of ton-miles per route, or to describe the many variants of merchant ships at sea from the mouth of the Amazon to Bering Sea as somehow a composite world fleet is to say nothing of value.
2. One must get beyond the superficiality of global value chain diagrams to gain an understanding of the flow of strategic goods in the world economy, which, in turn, provides insight into where high risk resides and how potential disruption might occur.
3. One must have differentiating knowledge of major ship types, sufficient to be skeptical. Operating a string of regional tankers is a very different business than that of ocean-going supertankers, and neither have much in common with container shipping. Economics in deep-sea shipping drives size of ships larger and larger, but sharply limits routes and ports. Once one has a working knowledge of container ships, Vladivostok, like Murmansk, falls off the list of terminals for the Northern Sea Route. Vladivostok is a tiny harbor, little more than an extended inlet, with a container quayside depth of less than 12 meters today. That's good enough for warships, but only the smallest container ships can dock in those waters. Although it is connected to the Russian rail system, its total rail infrastructure is less than half a marathon runner's distance.

The shipping industry, then, simply is not a homogeneous business. At its roots, however, there are clear traditional branches, which divide the industry by segments, types of services, by ownership and registry, and by cargoes and types of ships that carry them.

SEGMENTS AND SERVICES

There are two broad segments: short-sea and deep-sea shipping. Short-sea shipping refers to regional shipping, which varies across the world, and is a substantial part of the industry, both in terms of volume and numbers of ships. Deep-sea shipping is the industry term for ships that cross the oceans between large ports.

In both segments, there is a second division by the type of service shipping companies provide. Scheduled service is known as “liner” service. Liners can be any type of ship. Ferries across bays and great ships that move across the oceans on a scheduled route are both liners. Ships that do not keep schedules, but are hired out on a cargo by cargo basis are known as “tramps.” Before the Second World War, some deep shipping was conducted by tramps, keeping a way of life that is the stuff of 1950s movies, but today it is all but extinct. As a result, deep-sea shipping is the exclusive realm of large shipping concerns that provide liner service between the world’s major port-to-port routes. On short-sea routes, however, tramps are an essential and growing service element, especially in transshipment.

Short-Sea Shipping

The role of short-sea shipping varies across the world according to volumes of trade, geography and hinterland connections. Both passenger and freight are carried. Passenger ferries are a key part of the industry, and they are large part of the regional fabric of transport in many parts of the world. While they do not generally impact world shipping, they do provide a significant market for ferry companies and small shipyards. They are also a principal means of transportation in a number of areas.

In particular, in Europe, the North, Baltic, Mediterranean, and Black Seas depend on them. In North America, ferries are a key market sector in the large Pacific harbor areas of San Francisco, Puget Sound, Vancouver, and northward to Alaska. They also play a significant role along the Great Lakes/St Lawrence Seaway. They are not a common means of transport in the Caribbean Sea. In Asia, Japan, Philippines, Indonesia, South Korea and China all have significant services.

Short Sea Cargo

Of greater impact are short-sea cargo carriers and tankers, which are increasing in their overall volume of trade as well as their importance, for three important reasons:

1. They enable cargo movement of all types in regions where port infrastructure is rudimentary. Several ship classes are specifically designed for these routes.

2. Also, in those parts of the world where large bodies of water separate ports and cities, they are the principal means of transport.
3. As containerization is evolving, there is an increasing trend toward hub and spoke transshipment, and new classes of “feeder” container ships are emerging.

There is a much greater diversity in ships used on short-sea routes than deep-sea routes. Some of these are:

- Small tankers and dry-bulk carriers, which are often carried by tramp companies (though many may have long-term contracts.) These come in two types, those built for use on large seas (e.g. Mediterranean, Baltic, Caribbean) and those built for riverine traffic. Worldwide, the workhorse for the former routes is a design known as Handysize.
- General cargo carriers, which may be of several types and may be liners or tramps. These also tend to break out into those that ply large sea routes and riverine vessels.

Small container ships used for transshipping containers are known as “feeder ships.” They tend to be newer ships and are usually operated by a liner company. Specialized ships, such as roll-on, roll off and refrigerator ships are also common on short-sea routes. These are usually liners as well.

“Break bulk” cargos are those that are stowed individually in bags, crates, drums, or barrels and are hoisted on pallets or skids for loading and unloading. Break bulk is carried on “general cargo” ships and tend to be tramps.

Short-sea shipping is by nature regional and highly diverse. Despite the term “short-sea” in some parts of the world, they can have very long routes, especially tankers and bulk carriers, which often carry their cargos deep into inland regions via the great rivers of the world. In the Amazon basin, for example, every type of cargo imaginable is transported, because there is no rail or road alternative east to west. Indeed, South America is one of the largest short-sea markets because the Amazon also blocks north-south continental transit east of the Andes Mountains, divides the continent. Unlike North America, east-west road and rail has never been constructed. As a result, both the economies and cultures of South America tend to be divided quite sharply between those on the Atlantic and these on the Pacific.

In North America, short-sea ships can transit 3,700 kilometers from the Atlantic

Ocean to the western shore of Lake Superior via the St. Lawrence Seaway and the Great Lakes complex, which also provides key access to both the US and Canadian rail hubs. Ocean-going ships can ply the Mississippi River as well. In China, the three great basins of the Yellow River, the Yangtze and the Pearl Rivers are key enablers of its economy.

Russia is an opposite situation — only the Volga-Don system is functionally navigable by commercial shipping. The great Siberian rivers — the Ob, the Yenisey, and the Lena — are the only inroads from the Arctic Ocean, and none are presently viable far inland.

In Europe, short-sea shipping plays an especially critical role. High-speed freight rail from the North Sea ports is very limited, and there is none from the Mediterranean northward. Fully 60 percent of maritime shipping in the EU is short shipping.

Deep Sea Shipping, Liners and Routes

Statistics in shipping are best taken with a modicum of skepticism. Claims to be the largest ship, the longest ship, the biggest port, the busiest port and so on are highly changeable and require a lot of caveats. This is especially true of generalizations of world shipping lanes.

If one were to map the most important routes in the world — by type of cargo, or value of cargo, or by strategic value in terms of being a potential choke point — entirely different views would emerge. This is because deep-sea routes vary by segment, and three major segments have varied across past decades significantly as markets and, especially calculations for economies of scale have changed.

A quick look at world trade routes will generally surface the routes of container ships, which carry intermediate and finished goods. But Port Hedland, Australia or Ponta da Madeira, Brazil wouldn't be on that on such a list, though these two iron-loading ports, ton for ton, carry more cargo than any other in the world.

Routes for crude oil tankers, are different still from routes for refined petroleum carriers, necessarily reflect points of production, as well as transshipment and storage facilities, and ultimate destinations. For crude oil, six strategic passages are critical for the world at large. The Strait of Hormuz and Bab el-Mandab are the keys to Mid-East oil supplies. The Suez Canal plays an important, but largely regional role in oil transport to Europe because only small tankers can make the passage. Central Asian and Black Sea oil comes via the Turkish Straits. The Strait of Malacca is the shortest passage from the Middle East to the Far East. The Panama Canal is a strategic passage for North American crude. Though all six have great strategic importance, the amount of flow is significantly different. The routes above are listed in order from most barrels transported per day to

the least. The Strait of Hormuz transported about 16,5 billion barrels per day in 2013, while the Panama Canal transferred only about a half million. As we discuss below, each of these chokepoints requires different ship designs.

In the case of agricultural products, routes are even more varied. Take nuts, one of the world's most important food exports in terms of economic value, as an example. The largest cash crop worldwide is almonds, which are dominated by California growers and exported primarily to Europe and only secondarily to the Far East. Cashews, on the other hand, are grown largely in West Africa and, overwhelmingly, the import market is India, followed by Vietnam. They are removed from the shell, and shipped in containers all over the world. Pistachios, on the other hand, come from California and Iran in large part and China is the largest importer.

Fruit poses particular challenges, especially bananas, which is the world's most consumed fruit and has been since United Fruit Company created its famous Banana Republics in the 1910s. Bananas, in fact, have had much to do with the development of shipping historically. Bananas are a difficult fruit. Unlike peaches or plums, bananas all ripen at nearly the same rate, arriving at the store green and cycling from yellow to flecked with brown in almost exactly seven days. To get them there, Chiquita, Del Monte, and Dole Foods built shipping fleets to get them from Central America and South America — principally Ecuador — to market. In the 1980s, these companies controlled about two-thirds of the world market.

To chart the flow of bananas, then, one would immediately spin the globe to the Ecuadorian port of Guayaquil and find company fleets. Two developments intervened, which illustrates the temporality of trade routes:

1. Refrigerated containers made it possible for smaller growers to compete.
2. Bananas are dying off around the world from a fungal disease, for which there is no known cure.

Growers packed up bananas and moved them elsewhere in the world, and keep doing so regularly because the fungus follows. Thus, the business of shipping bananas involves entirely new routes, and those routes last as long as the plantations survive before growers move on. This has eroded what once was a monopoly: the market share of the big three has declined to one-third.

Once one moves perspective to a specific commodity or a value chain, the world's shipping routes take shape in useful detail.

In each segment — tankers, bulkers, and container ships — routes have specific physical and economic dimensions, and many routes, are different on the outbound

and homeward legs. The costs and prices of carrying freight, as well as the volume of traffic, on each leg of each route are very carefully watched in the industry as a primary measure of shipping supply and demand.

Taken together these factors, added to the ports of origin and destination, and placed alongside estimates of economic demand and profit, potential drive both the numbers and designs of ships on trade routes and define the make up the world merchant fleet. *When routes and their market underpinnings are stable, the longevity of a purpose-built ship is extended, making the capital risk of investing in a specific class of ships more attractive. When fundamentals change quickly, which is a primary characteristic of globalized value chains, the physical world of shipping struggles to keep up with the virtual world of finance and consumer goods.*

This is particularly important in the shipping of bulk commodities, where the point of origin is fixed by the source of the commodity. When market demand arises or shifts to different region, on a new route, an entirely new calculus for cost and competition emerges. In the past 15 years, as China has become the primary market for iron ore. The world's largest producer, Brazil's Vale, SA, with mines of the South Atlantic coast has found suddenly itself in a life and death struggle with competitors BHP Billiton and Rio Tinto, which mine in Western Australia.

OWNERSHIP AND REGISTRY

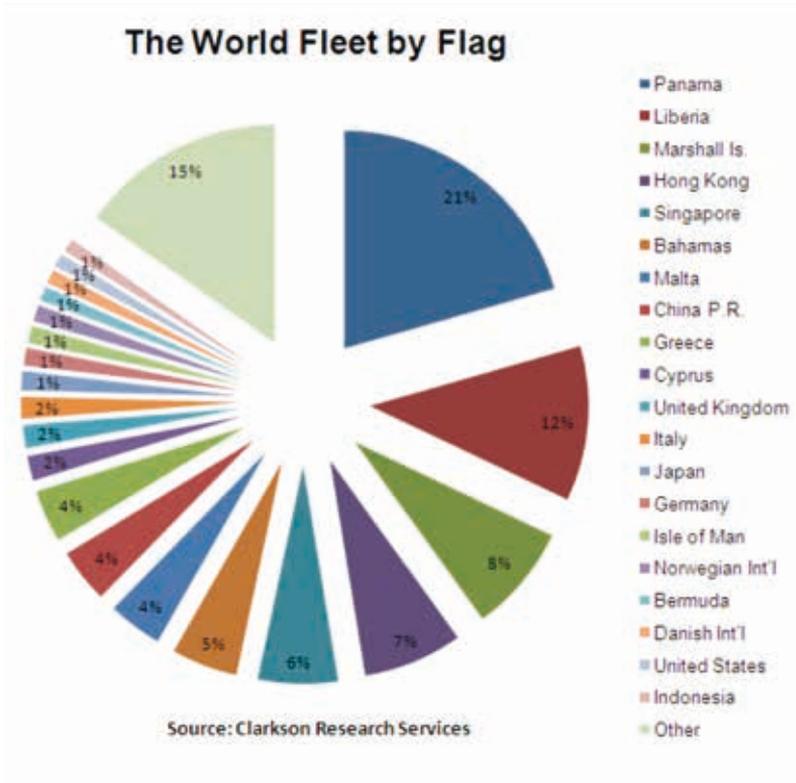


Figure 3. Major Flags in Shipping.

A third set of very complex divisions deals with types of ownership and national registry. Ships may be owned by individuals, by corporations, and by nation states, which may operate them directly or charter them in a variety of contractual structures. Either way, international law requires ships should be registered in a country, called its “flag state.” A ship’s flag state exercises regulatory control over the vessel and is required to inspect it regularly, certify the ship’s equipment and crew, and issue safety and pollution prevention documents. The organization that actually registers the ship is known as its “registry.” Since the 1920s, the practice of flagging ships in foreign nations has allowed ship owners to avoid regulation, responsibility in accidents, and hiring of unionized crews — led, as it happens, by the barons of the Banana Republics.

When ships are owned and registered by major seagoing nations, they are known as merchant marines. From ancient times, navies are maintained to protect their

merchant marines and safeguard access to the strategic lines of communication on the high seas. Today this practice has become lopsided. The US, which has almost no merchant marine, is by far the largest naval power in the world, and on its own is able to project air power larger and far more powerful than nearly all the world's air forces. The EU, with the world's largest merchant shipping fleets, has virtually no naval power, and nearly all of it will be resident in the UK's two new aircraft carriers on ways. This has significant implications with respect to the defense of the Suez Canal, which is addressed in that section below.

China, in contrast to both regions, has a large and growing merchant marine as well a fleet just as large under foreign flags, and a growing and increasingly capable navy. This has brought the US and China into a growing and very serious military conflict that has seen both nations escalate naval arms since the early 2000s.

SHIP TYPES AND CARGOS



Figure 4. Ship Types and Cargos.

Finally, the most obvious way to divide the industry is by ship types, which are subdivided twice, first by the type of cargo they carry and by size according to regional limits. But technological change in shipbuilding, as well as route economics, makes these divisions a shifting taxonomy. Ships don't define shipping as they once did; shipping now defines ships. Since their introduction, container ships have eliminated other specialized ships, notably refrigerator ships, and container technology expands, they are well on its way to displacing others, some chemical carriers. At the same time, the move to ship ores and coal across the world to China has resulted in the development of immense purpose-built dry bulk ships. While the trend has been toward ever larger ships, oil tankers, on the other hand, are in a state of flux.

Here a note how tramps operated:

- A typical tramp itinerary in the 1930s illustrates how the tramp business worked. The ship was chartered to carry rails from Middlesbrough to Calcutta. From there it loaded jute gunny-bags for Sydney, then ballasted to Newcastle, NSW, to load coal for Iquique in Chile, expecting to load nitrate.
- However, there were many ships waiting in the nitrate ports, so instead, after an exchange of cables, the ship ballasted to the River Plate where the maize harvest would soon be coming forward and demand was expected to be brisk.
- However, by the time the ship reached Buenos Aires many ships had recently arrived with coal from Britain and were looking for a backhaul, so supply exceeded demand. After waiting a couple of weeks it was eventually fixed at a slightly higher rate by a maize trader with an option to discharge in London, Rotterdam or Genoa, for each of which a freight was specified.
- The ship was to call for orders at St Vincent in the Cape Verde Isles, where the master learned he was to proceed to Rotterdam, then load coal for Genoa. From Genoa he was instructed to proceed to Algeria and load iron ore for the Tees.

SHIP TYPES

A working taxonomy today can be reduced to these three large groups — tankers, dry-bulk carriers and containers. They are by no means, however, the only ships at sea, or even the majority. Other types of ships — roll-on roll-off vehicle carriers, factory fisheries, icebreakers, research ships, and heavy lift vessels built to work the offshore oil business are all obviously important.

We emphasize the tankers, dry-bulk carriers, and container ships in this work because the directions in the shipping industry and in its geopolitical reflections can be seen clearly from the trends in these carriers — as they go, so goes the global maritime shipping. An important caveat, however, is the deep-sea variations, those that quickly come to mind when we think of these ships, have been designed for specific routes. They are liners that are predicated on a continuation of global trade patterns of today, which are by no means certain to be those of the future.

Each of the three major ship types is different business. For those ships that carry commodities profits turns on the value of the commodities, both present and future, the costs of production, and the points of origin and destination. These have been moving targets for the last 25 years. In the dry bulk business, the weight of cargos drives economies of scale toward larger ships, while in manufactured goods, the same trend toward larger ships is visible, but for different reasons.

In the commodities business, shipping can be a game of geopolitical chess. By far, the best way to ship heavy commodities is by rail, which, of course, can only be done when there is rail. Generally, North America's hinterland infrastructure, both rail and road, works for it, while Russia's near lack of it, except along its southern border, is a serious economic damper.

But there are exceptions. Commodities have to be moved from where they are found to where they are in demand. For example, one of the world's most important commodities is potash — water-soluble potassium salt — which is used to produce fertilizer. Without potash, the world's agriculture production would plummet. The largest producer of potash is PotashCorp in Saskatchewan, Canada, part of a larger Canadian consortium called Canpotex. The world's second largest was the Belarusian Potash Company (BPC). Together, for years, the two controlled nearly all of the world's trade in potash. Then amid great drama, however, the Russian partner in BPC pulled out of the cartel in June 2013, cutting an independent contract with China, which bought a sovereign-funded 12 percent share of the Russian company, Uralkal.

The net effect was to break up the long-standing duopoly, dropping potash prices like a stone on world markets. Since China is at present the world's largest consumer of potash, and potash is found near the Russian rail, Russia's advantage to market is absolute. Belarus's disadvantage is also absolute. Its sole route to China is via Russian rail. Canada has to ship potash outside of North America by sea, and,

now that the Chinese-Russian move has dropped potash prices, Canadian cartel stocks have dropped as well. Nothing about his drama deals with market forces or competitive pricing of potash. It has to do with strategies of monopolization, in which transport plays a great role.

Another more visible example is iron ore. *Iron is the most critical industrial commodity in the world. Yet, it is wide open for disruptive technologies and new production techniques. Counterintuitively, it is not competition in iron production or prices that is the threat, but rather the potential to replace steel. Material science is iron's greatest competitor. The development of non-steel substitutes would act to reverse much of the world's dry-bulk shipping overnight, as well as China's dominance in the world economy, which rests on steel.* The world's best selling automotive vehicle is the Ford F-150 truck. Its 2013 model discontinued steel and is now built from aluminum. Before making that move, Ford made significant investments in bauxite through off-shore companies. Fully one-third of world shipping is dry-bulk, and by far iron ore is the largest cargo, by tonnage, by value, and by ton-miles. It is highly vulnerable.

Ship Designs

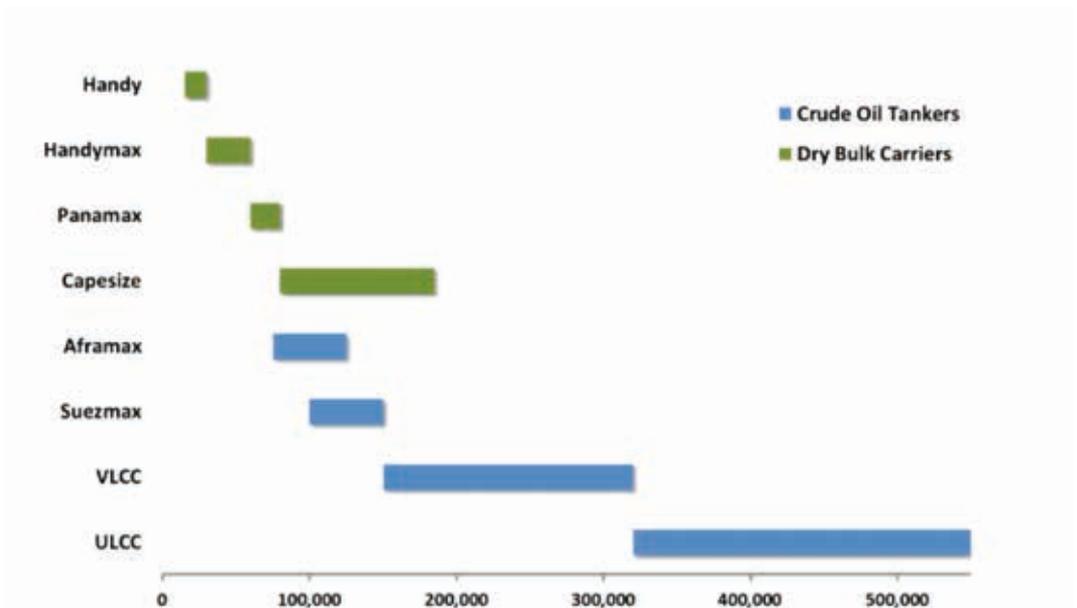


Figure 5. Shipsizes.

Ships designs have distinct hierarchies. While the major divisions are tankers, dry-bulk vessels, and container ships, each of those is further subdivided in various ways. For example, oil tankers include both crude carriers and refined carriers, which are designed differently. In addition, tankers designed to transit the Suez Canal require specific size attributes that are different from those that transit the Panama Canal and still different from those that take the routes around the African Capes. The names of the designs reflect categories, not actual ships. Different naval engineers and shipyards produce somewhat different designs within a class. For example, two different shipyards may produce slightly different vessels of the size for Suez Canal transit, but both would be classified as “Suezmax.”

Ships are measured by length, beam, draft and tonnage. Of these, the last three are differentiating. Beam and draft are important characteristics that limit transit through some of the world’s narrow routes and ports. Both the Suez Canal and the Panama Canal have limits, as does the important international Strait of Malacca, which is only 25 meters deep.

Accommodating ships of deep draft is a critical factor for major ports to be profitable, but it is a difficult and expensive problem in many, especially those that are located downstream on rivers. This is one of the main limiting factors in Murmansk, for example. The North Sea ports have been dredged and expanded many times over their history. For other ports, size is virtually unlimited. San Francisco, for example, is the largest natural harbor of any of the world’s great trading ports. Once inside, the bay is sixty kilometers long, and averages five miles in width. Much of the world fleet could anchor in perfect safety. Port Philip bay, the chief harbor of Victoria, Australia, is even larger, being about forty kilometers long by thirty-five broad, but its very breadth, with its surroundings, leaves it exposed to storms from certain quarters.

Overall tonnage except insofar as it effects draft is generally not a concern except for the largest crude tankers and ore carriers. Presently the largest tankers in the world are four ships constructed for the Greek shipping company Hellenic by Daewoo shipyards in South Korea. They are nearly 450,000 deadweight tonnage with drafts exceeding 24 meters. They are only financially viable when crude prices are high, and even then they are sharply limited in terms of routes and ports. Two of these Ultra Large Crude Carriers (ULCCs) have been converted to floating production and storage vessels of Qatar. The new ore carriers, build first by Vale and are being designed now by others as well, are more than 400,000 deadweight tonnage. Unlike the ULCCs, the ore carriers were designed to enter ports rather than transship at terminals offshore. They are so large that the sinking of one in a port (or narrow strait) could close it for months. One of Vale’s new Valemax carriers, the Vale Beijing, suffered structural damage while being loaded at the Brazilian port of Ponta da Madeira in 2011 and had to be towed to sea before she sank.

Ships can be bought outright, new or used, or chartered from ship-owning companies that specialize in the sizes. The price of each type of vessel is a floating mark that is carefully watched within the industry as a measure of shipping demand and supply. Because companies can sell and purchase 15-year-old ships in the market right away —unlike new builds, which can take up to two years to construct — price movements in 15-year-old ships reflect nearer-term fundamentals than new build prices. In early 2008, before the market crashed, average vessel prices for 15-year-old Panamax and the smaller Handysize, Handymax, Supramax vessels were around \$100,000. By January 2013, they fetched less than \$20,000 each.

Small cargo ships are typically designed in one of three classes — Handysize, Handymax, and Supramax — and range from 15,000 to 60,000 deadweight tonnage. They can be tankers or bulk carriers, and some design is modified for modest cargos of both. Within the slang of the industry, all three are sometimes lumped under the common term “Handysize.”

Handysize is the smallest commercially produced design, typically between 15,000 and 35,000 deadweight tonnage. It is used frequently for refined petroleum products. It is fitted with its own gear and has a shallow draft, which allows it to offload cargo in small ports. Most of handysize vessels operate within regional trade routes. They are used to carry small bulk cargoes, often in parcel size where individual cargo holds may have a different commodity. Their dry bulk cargo list is long and includes iron ore, coal, cement, phosphate, finished steel products, wooden logs, fertilizer, and grains to name a few. Handysize vessels are primarily built by shipyards in Japan, South Korea, China, Vietnam, India and the Philippines, though some other countries also have the expertise and capacity to build them. The most typical handysize ships being built today are of size 32,000 deadweight tonnage with a draught of 10 meters. They have five cargo holds with four on-deck cranes for cargo handling. Some of handysize ships are also equipped with stanchions for easy loading of wooden logs on deck.

Handymax and Supramax are two other small cargo ships of less than 60,000 deadweight tonnage. Handymax is the smaller of the two, typically around 45,000 deadweight tonnage, while Supramax is larger, between 50,000 and 60,000 deadweight tonnage. These two are the workhorses of the general merchant fleet worldwide.

There are several mid-size designs. Panamax vessels, found in a variety of merchant ship designs, from general cargo to dry-bulk, tankers, and container ships, transit the Panama Canal. These are the largest ship size capable of passing through the original lock chambers of the Panama Canal, which have strict dimensions: 294 meters in length, 32 meters in width and 12 meters draft. Panamax ships have been in operation since the opening of the Panama Canal in 1914. As tankers, they typically carry refined products regionally and are known as product tankers.

In terms of tonnage, Panamax vessels range from 60,000 to 80,000 deadweight tonnage. With the expansion of the Panama Canal, larger ships are able to transit. These are known as New-Panamax and will include large container ships carrying up to 13,000 TEU, nearly three times that of Panamax ships. Ships of a size that are not able to transit the canal at all are known broadly as Post-Panamax or sometimes as over-Panamax.

Aframax is a medium-sized tanker design between 80,000 and 120,000 deadweight tonnage designed for Black Sea and Mediterranean Sea transit but is used extensively throughout Europe. Due to their small size, Aframax tankers are especially suited to serve regions that do not have very large ports or offshore oil terminals to accommodate larger crude carriers.

Suezmax ships are also medium-sized tankers, but are much larger than either Panamax or Aframax, and some newer designs are the same tonnage as large tankers. They are designed to the specifications of the canal, which limits them to a draft of 20 meters and a beam of 50 meters. These are exclusively tankers, typically about 160,000 deadweight tonnage.

Large ships begin in size with Capesize, a very broad category including both bulk carriers and tankers, between 150,000 and 400,000 deadweight tonnage. As the name suggests, their size required them to transit the African or, rarely, South American cape routes. The expansion of the Suez Canal in 2009 permits many of them to transit it. With Capesize designation, design names and terminologies begin to become less precise. Many Capesize ships are bulk carriers, and of these nearly all carry iron ore or coal. Because of this fact, the term Capesize is often used for bulk carriers rather than tankers. In the subcategory of Capesize vessels include the very large ore carriers (VLOC) and very large bulk carriers (VLBC) of above 200,000 deadweight tonnage. The largest size of ore carriers today is much larger, and though technically still in the Capesize category, they are known as Chinamax (or Valemax).

Among tankers, two common designations of “supertankers” are VLCC or Very Large Crude Carriers and ULCC or Ultra Large Crude Carriers. These are the largest operating cargo vessels in the world. For reasons we shall come to in the discussions below, ULCC ships have not been successful. VLCC ships are the norm for long-haul crude transportation from the Persian Gulf to countries in Europe, Asia and, until recently, North America.

Regional categories also exist. For example, Seawaymax refers to the largest vessel that can pass through the canal locks of the St Lawrence Seaway in Canada. Malaccamax refers to the largest vessel that can pass through the Straits of Malacca. Kamsarmax vessels are larger than Panamax, and specialized for berthing at the Port of Kamsar in the Republic of Guinea, which is a major terminal for bauxite. Newcastlemax refers to the largest vessel able to enter the port of Newcastle, Australia.

Tankers

From the 1870s until the 1914s, an unprecedented stability in world shipping prevailed, in routes, in cargos, and in costs. In the main, this reflected two developments, the directions of colonial trade and the supremacy of new ship technologies that displaced sailing ships. Three inventions made this possible: steam propulsion, iron hulls, and screw propellers. A fourth, undersea telegraph cable, made it possible through shipping exchanges for masters to arrange return cargos, which largely eliminated one of the most difficult problems in shipping: returning with empty holds, a malady shippers call “ballast legs.” Sea trade increased from 20 million tons in 1840 to 140 million tons in 1887. At the same time, industrial cargoes began to appear on the market in very large quantities, the most important being the coal trade. Coal tonnage alone increased from 1,4 million tons in 1840 to 49,3 million tons in 1887. On major routes, passenger liners emerged, though cargo was always carried below decks. On lesser routes, freighters, today known as general cargo ships, carried both.

Then, in the late 1880s, the first ship resembling modern oil tankers emerged, fostered by increasing global demand for oil, while supply was largely limited to only two major producing oil fields in the US and Azerbaijan. The first attempts to ship oil by barrels on break-bulk ships proved expensive, and a solution was found in the development of the first tankers. By the first decade of the 1900s, Royal Dutch Shell and Standard Oil both had tanker fleets operating on the Far East trades.

The major development in oil tanking, however, was provided by the wholesale migration of the Royal Navy from coal to oil. It has been an oft-related story in the saga of the oil industry, but the conversion of the fleet to oil had profound consequences that shaped the entire shipping industry, right down to today as the largest tanker companies in the world, are teetering on the same brink as the container and ore shippers.

The Royal Navy needed speed, in short. One of Britain’s greatest admirals, Jackie Fisher, was convinced of it. Without speed, the Royal Navy’s aging battleships would not be able to outmaneuver the emergent German fleet of the day. As Fisher rose to power he pummeled Winston Churchill into a collaboration to a fast battleship division around Fisher’s brainchild, HMS Dreadnought. Other navies had built prototypical ships, but what Fisher was after was a fast battleship division that could outmaneuver the emergent German navy. That required 25 knots, and that required oil.

In reality, however, it required far more — decades of British adventures in the Iran and Iraq, the subsequent necessity to defend the Suez Canal at all costs, and government investment to the tune of 51 percent in Anglo-Persian Oil, which made the first discoveries in the Persian Gulf. Ultimately, and at length with the help

of the US, especially by CIA, and along with the establishment of Israel, a series of antics would result in the deposition of the Shah of Iran, the destabilization of the Middle East, and change the direction and flow of world trade.

In turn, it was this decision that fostered the first substantial development in tankers. The earliest tankers served only moderately growing markets, and they collapsed with the same suddenness that the rest of world economic activity did after 1929. The necessity to build tankers for naval forces did not slow, particularly in the US where naval planners were faced with getting its tiny fleet from an Atlantic base to the Pacific in the event of a Japanese invasion of the Philippines. When the war did break out, more than 500 tankers were built, and when the war ended, these were sold at auction. Among the buyers were Greek, Maersk and Norwegian Fredriksen, who is the presently the owner of Frontline Ltd, the largest tanker charterer in the world.

After World War II, the discovery of the Gahwar Field in Saudi Arabia created the world's first permanent large tanker route, and the Strait of Hormuz has dominated the oil trade since then, driving the tanker markets forward. The first generation of post-war tankers were built to transit the Suez Canal, but repeated closures forced Middle East oil transit around the African Cape of Good Hope.

As the US began to import more and more oil, supertankers were developed. By the 1970s, the largest tankers in service reached 500,000 tons, a vast increase over the tankers of the 16,000-ton or so tankers of the 1950s. The world's largest supertanker was built in 1979 as the Seawise Giant, with a capacity of 564,763 deadweight tonnage. Fully loaded, she could not navigate the English Channel.

Then, as worldwide tanker traffic increased during the 1970s and 1980s, a series of disastrous oil spills from tankers occurred around the world, leading to the requirement for double-hulled tankers, and ushering in a second major restructuring of the world tanker fleet in just three decades.

Today, yet another fundamental restructuring is underway as the global energy map is being redrawn amid a number of new developments. The tanker market is dominated by independent shipping companies that charter out their vessels. The ten largest independent tanker companies together own more than 25 percent of the fleet. Charter rates for VLCC tankers fell from \$32,700 per day in the first quarter of 2014 to \$13,900 in the second quarter, while Suezmax rates fell from \$27,700 to \$12,400.

Frontline, the world's largest tanker company, like Maersk, which is in the top ten largest tanker companies, is struggling, and in late 2014 Frontline announced it would have to terminate some of its charter contracts and that it would merge with another major independent. Nor is it the only merger in the works. Thus, like container shipping, the number of shipping companies is necking down, and Maersk is highly exposed in both segments.

In the crude markets, crude oil imports into the US have declined sharply in the past 5 years due to domestic production from oil sands and fracking of shales. The International Energy Agency expects the United States to become a net exporter of natural gas by 2020 and to overtake Saudi Arabia as the largest global oil producer by the same year as Middle East reserves decline. This has resulted in significant directional changes in crude transit: despite the continuing involvement of the US troops in the Middle East since 1990, nearly all oil from Hormuz now goes to the Far East.

In the Middle East, although data on reserves is very closely held, it is widely believed that only Iraq has substantial remaining reserves, and that country's third decade of civil wars brings that production into some doubt. International sanctions on Iranian oil continue, but China, India, and the Republic of Korea continue to import from there by reducing volumes below a 180-day waiver limit in the embargo. This has a net effect of shifting Middle East oil tanking (from Iran) to the Far East.

Meanwhile, around the world pipelines are increasing and will take trade from tankers where possible, particularly from Central Asian sources. Tankers have account for two-thirds of the world's oil trade, but pipeline transfer is cheaper. In this regard, geography also matters. The Strait of Hormuz has long been the world's most strategic passage for oil, but a large percentage has been driven by the US exports. As the US imports fall, crude from traditional suppliers outside the Middle East, such as Angola, Nigeria, and Venezuela, is being directed elsewhere: to Europe, as North Sea production decreases, and to India and China. Pipeline construction across Central Asia and from Russia to the Pacific coasts, would have a dramatic impact on Gulf transport and reduce China's dependence on the Indonesian straits.

Refined petroleum shipment is also decreasing as refineries move closer to consumer destinations. In particular, refineries in Europe and Japan are coming under pressure and shutting due to environmental constraints, with the effect of creating new competition from refineries in Western Asia and the Far East. There is considerable growing evidence that natural gas may displace refined oil distillates as technology changes, a development that would impact tanking in those products. For example, battery-based automobiles ultimately derive power from power plants, which are switching to the cleaner and cheaper natural gas supplies.

Tanker Development

Ludvig Nobel's Zoroaster was the world's first successful oil tanker, built to carry crude from the Nobel wells at Baku in the Azerbaijan in 1878. To compete with the American Standard Oil Corporation in the Far East trade, another group of

oilmen built three new tankers, the first able to pass through the Suez Canal in 1892, naming them after shells: Murex, Conch, and Clam. These ships were the first fleet of what grew to be Shell Oil, which merged with Royal Dutch Petroleum in what was then the Dutch East Indies, part of a long line of corporate descendants of today's Royal Dutch Shell. In 1901, on the other side of the world in Beaumont, Texas, a gusher of oil from a salt dome known as Spindletop set off a search for oil throughout the US and the Caribbean, fostering in its wake oil giants that included Gulf Oil and Texaco (now part of Chevron), the Mexican state-owned PEMEX, and in Venezuela, Royal Dutch Shell's first wells outside of Indonesia. The demand for tankers fostered the first independent tanker companies, which today still accounts for 80 percent of the world fleet.

The ten largest independent tanker companies together own more than 25 percent of the fleet. The largest tankers today are over 1,000 feet long and carry more than 2 billion barrels each. Tankers account for two-thirds of the world's oil trade.

Case: Amoco Cadiz

Tanker design was changed forever after a series of disastrous oil spills. The Amoco Cadiz, a very large crude carrier, ran aground in 1978 off the coast of Brittany, split into three parts and sank releasing 1.6 million barrels of oil in the largest tanker spill in history. Although the ship was flying a Liberian flag, she was owned by the American oil conglomerate Amoco. More than a decade later, Amoco was ordered to pay \$120 million in damages and restitution to France. Amoco has since merged into BP. In 1991, a sister ship chartered to Troodos Shipping, ran aground off Genoa, spilling 1 million barrels of crude in the worst oil disaster in Mediterranean history.

How the US Crude Impacts the Tanker Market

The tanker fleet is declining, and not because of the 2008 financial collapse. Worldwide there are three trends:

1. While crude exports are increasing, the price is dropping.
2. Natural gas is begging to dig into the market for refined crude productions.
3. And of genuine earth-shaking impact, is the sudden resurrection of the US crude exports.

The US crude production declined sharply after the early 1950s when the East Texas and Louisiana oil fields began to play out. Except for production spikes to compensate for the Gulf Wars, US imports have continued to increase, as did the market for crude tankers from the Middle East.

But since 2008, hydraulic fracturing of oil shale and the new technologies that allow production of from oil sands, has made the US self-sufficient in energy. The US oil production has jumped from 5 million in 2008 to 10 million barrels per day in 2014. This boom, along with a rise in natural gas liquids production, has dramatically lowered petroleum imports. The share of the US liquid fuels consumption met by net imports, down from 60% in 2005 to 33% in 2013, is expected to fall to 22% in 2015, which would be the lowest since 1970.

The US and Canada are expected to account for most of the world's projected growth in production of oil and other liquid fuel through 2015 while China and less developed countries will drive most of the growth in consumption, according to the EIA's July forecast. Meanwhile Iranian oil is embargoed, while Iraq descends into the brutal nightmare of the ISIS terrorist group. These events have profound implications worldwide.

As a result, the world market for oil tankers is both dropping and changing. The pain centers primarily on the steep decline in long-haul imports into the US that has brought VLCC earnings on the US-bound trades to the floor. Even though the domestic US production is foremost in driving West African imports out of the market, the effect tears across the market.

Crude oil tanker asset values continue to decline, with a clear tendency that elderly tonnage declines the most percentage-wise. Over the past 20 months, a 2005-built VLCC has lost half of its second-hand value, and a 2009-built VLCC has lost 40 percent.

Dry-Bulk Carriers

One of the greatest changes in shipping in the past 25 years is the dramatic change in dry-bulk shipping. In the 1950s, most bulk cargo was carried in the tramp trade on ships of under 12,000 deadweight tonnage. The movement toward larger ships progressed slowly until the 1960s, when the dry bulk trades experienced a number of different developments that accelerated the trend.

Two in the agricultural trade were particularly significant:

1. Successive failures in grain harvests in the Soviet Union, from 1963 through 1979 lead to the development of large bulk grain ships moving grain from the Americas to Russia.

2. The banana industry, which had been at the cutting edge of shipping developments since the early 1900s, shipping from Central American to the US, began to ship worldwide.

Bananas are today, the world's largest fruit crop and the fourth-largest product grown overall, after wheat, rice, and corn. Bananas were only the beginning. Fruit shipment of all types followed, led by Dole Pineapple and United Fruit Company. This created the first specialized segment since oil, leading to the creation of refrigerator shipping and the wholesale shipment of highly perishable foodstuffs. It is the reason today that New Zealand apples are more plentiful in food stores than local apples. However, the boom in refrigerator ships declined rapidly after the introduction of containerized shipping, and continues to decline as the sophistication of containers has increased and as small feeder container ships have been able to make the transshipment of fruit from larger container ships more timely.

Certainly the largest development has been in ores and coal. It began with Japan's post-war reconstruction, which was based on developing heavy industry. Japan is almost completely lacking in industrial raw materials, and needed to import high-grade ores from the nearest source at the time, which was in Australia. The Japanese signed long-term contracts of a decade or more to ensure Australians could secure mining investment. As a result, ocean-going ore carriers began to appear a steady maritime segment. But global steel production grew only slowly, and iron-ore prices didn't change much until in 2003, when China slipped past Japan to become the world's biggest importer of iron ore. Today it accounts for 60 percent of total world imports. China's voracious appetite for iron ore in particular and ores in general, however, has led to one of the largest disruptions in the world economy since the 1973 OPEC oil embargo.

The demand for dry-bulk carrier capacity is determined by the underlying demand for commodities, which in turn is influenced by trends in the global economy. Seaborne dry-bulk trade increased by slightly more than 2 percent on an average annual basis during the 1980s and 1990s. Between 1999 and 2008, however, trade in all dry-bulk commodities increased almost 40 percent worldwide, but has fallen off sharply since the financial collapse in that year.

Over the past 25 years, dry-bulk carriers have emerged overtime into increasingly specialized vessels. Today, they are differentiated by cargo and specialization of cargo handling.

The simplest dry bulk carriers are known as "general" and "breakbulk" vessels and are usually found providing regional tramp services. Most are "geared," meaning they are equipped with their own cargo-loading equipment, commonly in the form of derricks. "General" cargo is stowed in different holds, making these

ships labor-intensive because the speed and effectiveness of the loading/unloading process depending on the skill of the ship's crew and the port workers. Cargo in the form of pallets or bags is known as "breakbulk" and is typically loaded and unloaded using cranes, straps, or slings. Loose or irregular cargo is also carried, requiring both the vessel's crew and port stevedores to pack the cargo to minimize damage and maximize the utilization of space. The efficiency of dry cargo vessels of these traditional types is low, with high labor costs, but ship construction costs are lower.

Up in size and specialization, there are mid-size dry bulk vessels, most carrying a single type of cargo and often shuttling between specific ports. A good example can be found in the Russian ore carriers that ship nickel from Norilsk mines in Western Siberia via the tiny Yenisei River port of Dudinka to Murmansk. Except for icebreakers, these constitute the majority of shipping along the Northern Passage and continue largely because there are neither rail alternatives as there are in other large mining regions in Western Australia, China, Canada, and Brazil. Elsewhere, in some small regional or niche markets, there are bulk carriers that carry multiple bulk cargo — coal, ore, timber and the like. Some of these shuttle from sea ports up and down waterways and rivers.

Midsized bulk carriers are commonly constructed to have multiple separate holds covered by hatches. In port, cargo is loaded by conveyor and spouts or by crane and grab. Some are fitted with cranes located between each hatch to allow the loading and unloading of cargo at berths without the need for shore equipment. Cargo usually is unloaded into hoppers and then transferred by conveyor to silos or open storage. Smaller bulkers may discharge directly into road vehicles.

From these, bulk carriers range upward from large to very large in size. These are generally purpose built to serve specific markets, which can be categorized into the cargo segments as either "major bulk" or "minor bulk". Major bulk cargo constitutes the vast majority of dry-bulk cargo by weight, and includes, among other things, iron ore, coal and grain. Minor bulk cargo includes products such as agricultural products, mineral cargoes (including metal concentrates), cement, forest products and steel products and represents the balance of the dry-bulk industry. In terms of seaborne trade volumes (and the shipping ton-miles generated), the dominant influence is that of the major bulk trades, which steel-related commodities, other metals, and grains.

Container Ships

Nearly all the world's containers are manufactured in China. Whether you see a shipping container from China Shipping, Maersk, Hapag-Lloyd, Evergreen, OOCL, Cronos, Hyundai, Hamburg, or any other shipping company, it was still

made in China. The world's largest manufacturer is the China International Marine Containers Company (CIMC), which is a state-owned enterprise with twelve different factories throughout China. CIMC holds more than 50 percent of the world market share. Behind CIMC is Singamas, another Chinese company, with 25 percent of the market share.

Depending on the type of products to be shipped or the special services needed from them, container units may vary in dimension, structure, and materials. Various types of shipping containers are being used today to meet requirements of all kinds of cargo shipping. Some of the most common types of shipping containers in use today are mentioned below.

DRY STORAGE CONTAINER. The most commonly used shipping containers; they come in various dimensions standardized by ISO. They are used for shipping of dry materials and come in size of 20 feet, 40 feet and 10 feet.

FLAT RACK CONTAINER. With collapsible sides, these are like simple storage shipping containers where the sides can be folded so as to make a flat rack for shipping of wide variety of goods.

OPEN TOP CONTAINER. With a convertible top that can be completely removed to make an open top so that materials of any height can be shipped easily.

TUNNEL CONTAINER. Container storage units provided with doors on both ends of the container, they are extremely helpful in quick loading and unloading of materials.

OPEN SIDE STORAGE CONTAINER. These storage units are provided with doors that can change into completely open sides providing a much wider room for loading of materials.

DOUBLE DOORS CONTAINER. They are kind of storage units that are provided with double doors, making a wider room for loading and unloading of materials. Construction materials include steel, iron etc in standardized sizes of 20 feet and 40 feet.

REFRIGERATED ISO CONTAINERS. These are temperature regulated shipping containers that always have a carefully controlled low temperature. They are exclusively used for shipment of perishable substances like fruits and vegetables over long distances.

INSULATED OR THERMAL CONTAINERS. These are the shipping storage containers that come with a regulated temperature control allowing them to maintain a higher temperature. The choice of material is so done to allow them long life without being damaged by constant exposure to high temperature. They are most suitable for long distance transportation of products.

TANKS. Container storage units used mostly for transportation of liquid materials, they are used by a huge proportion of entire shipping industry. They are mostly made of strong steel or other anti corrosive materials providing them with long life and protection to the materials.

CARGO STORAGE ROLL CONTAINER. A foldable container, this is one of the specialized container units made for purpose of transporting sets or stacks of materials. They are made of thick and strong wire mesh along with rollers that allows their easy movement.

HALF HEIGHT CONTAINERS. Another kind of shipping containers includes half height containers. Made mostly of steel, these containers are half the height of full sized containers. Used especially for good like coal, stones etc which need easy loading and unloading.

CAR CARRIERS. Car carriers are container storage units made especially for shipment of cars over long distances. They come with collapsible sides that help a car fit snugly inside the containers without the risk of being damaged or moving from the spot.

INTERMEDIATE BULK SHIFT CONTAINERS. These are specialized storage shipping containers made solely for the purpose of intermediate shipping of goods. They are designed to handle large amounts of materials and made for purpose of shipping materials to a destination where they can be further packed and sent off to final spot.

DRUMS. As the name suggests, circular shipping containers, made from a choice of materials like steel, light-weight metals, fiber, hard plastic et cetera. They are most suitable for bulk transport of liquid materials. They are smaller in size but due to their shape, may need extra space.

SPECIAL PURPOSE CONTAINERS. Not the ordinary containers, these are the container units, custom made for specialized purposes. Mostly, they are used for high profile services like shipment of weapons and arson. As such, their construction and material composition depends on the special purpose they need to cater to. But in most cases, security remains the top priority.

SWAP BODIES. They are a special kind of containers used mostly in Europe. Not made according to the ISO standards, they are not standardized shipping container units but extremely useful all the same. They are provided with a strong bottom and a convertible top making them suitable for shipping of many types of products.

The development of standardized containers is surely one of the great innovations of the 20th Century. Today, more than 90 percent of ocean-going non-bulk dry cargo travels in containers. In the past 20 years alone, the number of containers shipped has increased from

40 million to 170 million, and along the way their use has transformed maritime shipping of intermediate and manufactured goods and fostered the operational overlay of logistics. Containers are the physical lynchpin that enables global value chains. Their greatest impact, likely is yet to come, and it may take decades to realize.

So far, container shipping has been focused on the maritime leg — container ships and port infrastructure. Unlike the other two segments in shipping, containerization's greatest potential lies in transcending the ocean, linking manufacturing to consumers.

On land, container shipping is a very incomplete fabric: for all the conceptual discussion about transmodal shipping, most of the world's continental rail and road infrastructure has a very long way to go before it can provide real connectivity from factory to retail floors. This varies greatly by continent and region, as we shall explore further in subsequent sections. *Hinterland infrastructure, as shippers refer to road and rail, takes decades to build and great expenditures of capital. In contrast, ships can be built in 2-3 years. If container transfer begins to take root in the world's hinterlands, world trade will begin to look very different. When containers can be transported via inland rail, road, and air connections to the hinterlands, which not only makes it possible to create distributed production centers, but also opens up landlocked markets because of the reduced logistics costs of containerization.*

At sea, the trend has been toward ever larger container ships, which creates economies of scale for shipping companies and provides increased liner service for those shipping cargo, but the development of “feeder” infrastructure to create regional hub and spoke networks is still in comparative infancy. In part this has been caused by the collapse of container shipping in 2008, which dropped almost to nothing overnight and has struggled with up and down ticks since then. Generally, the costs of building ships is borne by shipping companies, though as we have seen not all shipping companies are alike. For Cosco to buy new ships in state-run shipyards with state investment funds is significantly easier than for a truly commercial shipping company.

Container shipping has been famously associated with the American trucking-company owner Malcom McLean, who put the first commercial container ship to sea in 1956. The story of container development, however, has a longer history, and like so much in the world, roots in the railroad industry.

Almost from the beginning railroads on several continents were carrying containers that could be transferred to other modes of transport. In 1830s, in Britain, simple rectangular timber boxes, four to a wagon, were used to convey coal from the Lancashire collieries to Liverpool, where they were transferred to horse-drawn carts by crane. By the late 1880s on all continents boxes on railroad cars that could be transferred in whole from factory spurs to main lines was a matter of common practice. In regions where roads and trucking grew, containers

did too. Railroad flat cars carried trucks already loaded with cargo from destination to destination, where they were driven off for transport into the cities. Bananas and the need to get them to market spurred the innovation of putting railroad cars directly into the holds of ships. Beginning in 1920s, Seatrains Lines carried railroad boxcars on its sea vessels to transport goods between New York and Cuba and elsewhere.

World War II provided the greatest impetus. The Australian Army used containers to help overcome the various breaks of gauge. The US Army used specialized containers to speed the loading and unloading of transport ships, adopting the term “transporters” to identify the containers. A transporter was a reusable container, about 3 meters long, by 2 meters wide and 2 meters high, made of rigid steel and with a carrying capacity of 9,000 pounds. In the first years after the war, as we have seen, shipping was being rebuilt in Europe, virtually non-existent in the Western Pacific, and in the US, building down from war levels. The Korean War occurred in the midst of this, and it was in that conflict that containerization was first used on a large scale. By 1950, the first shipments of containerized cargo, which were then known as “CONEXs,” began from the army general depot in Georgia by rail to San Francisco, then by ship to Yokohama and on to Korea — essentially a resumption of railroad initiatives before the war.

The great problem remained at the docks, and changing that posed to formidable challenges. The most difficult was that everywhere in the world, stevedores were solidly unionized, and in Europe and the US, the unions were notoriously controlled by organized crime. The move toward foreign flagging before the war decimated merchant seaman unions, which never recovered. To get rid of stevedores was more complicated, and nothing at all could be done until there was a technological means to do without them.

At the time, dockworkers performed the same tasks in the same way as in ancient Phoenicia — cranes, pulleys and nets, albeit now motorized and loaded onto trucks and trains. It was not unusual for a ship to take as long unloading as it did to make the passage across the ocean — particularly in the Pacific, where port facilities were not restored until two decades after the war in Japan, three decades in South Korea, and five decades afterward in China.

Crews of 20–22 longshoremen would pack individual cargoes into the hold of a ship. One study of a typical freighter of the time is instructive.

Case: SS Warrior in 1954

In 1954, the SS Warrior, alongside New York piers and bound for Bremerhaven, was loaded with 5,000 tons of goods divided among 194,000 cases, cartons, reels, barrels, drums and boxes, as well as 53 vehicles. Union contracts called for an 8-hour day, and it took six days to load her. Lash down costs in lumber and line cost the equivalent of 32,348 €. Transit to Bremerhaven took 10 days. Four more days were required to unload her there and a month longer for the last cargo to reach its destination. Time at sea amounted to less than 12 percent of the cost of shipping and handling the goods; more than 50 percent of the cost was pierside handling.

It was this that McLean resolved. His container design, which was the straightforward addition of welded hooks, along with modifications in the holds, allowed for the loading of containers by derrick. In April 1956, McLean put 58 containers aboard a refitted tanker ship, the SS Ideal X, and sailed them from Newark to Houston.

The term “revolution” often has been used to describe container shipping, its adoption took decades to overcome a long list of hurdles, many of which remain today in most of the world. The reason is that container shipping, in the jargon that was to come later, is a system of systems, one that necessitated change across a great many established infrastructures and the construction of much that was newly required.

For one, stevedores did not evaporate overnight. So entrenched was organized crime on the dock, that during the war, the US Navy turned to New York mob boss “Lucky” Luciano, even as he was distantly exiled in Sicily, for help in loading merchant shipping along the East Coast. Ultimately, in the US, stevedores would be destroyed through three tactics:

1. The first was a concerted lobbying effort in Congress by shipping and port companies to paint the unions as deeply penetrated by communist sympathizers. In the atmosphere of the late 1940s, this was easily done.
2. The second tactic was to complete the move that began before the war with United Fruit and Standard Oil to move what little remained of the US merchant shipping to ship charters and foreign-flagging.
3. The third tactic was to strand stevedores in old ports, leaving them to die on the vine as new ports were built.

Container shipping not only made this possible, it required it and not just in the US,

but all over the world. The type of port facilities needed to support containerization not only are very different from those needed for traditional break bulk ships, but also from those used for dry-bulk carriers and tankers. Container ports are real estate ventures: much land is needed for both for dock-side facilities, as well as immediate off-port warehousing and hinterland connections so that containers can be moved off the docks.

For this reason, the most successful container terminals have been those that were built from the ground up for that business. Efficient container terminals are situated on large, flat areas with easy access to highways and railways and ample space for storing containers and parking trucks. Quayside, massive gantry cranes are immediately quayside, and they have to be capable of hoisting or lowering a thirty-ton container into the lowest tier in the outermost row of a ship nearly fifty meters wide.

Moreover, significant command and control facilities are needed to ensure the smooth flow of containers requires a complex system able to orchestrate ships, trucks, and trains so that the right container goes on the right vehicle in the right order. Computer-generated loading plans have to take into account a container's weight and the port where it is to be offloaded. Determining the bay, tier, and row for each container on a ship that may carry upward of four thousand of them requires complex algorithms.

This infrastructure makes container ports completely incompatible with traditional working waterfronts. It is not an accident that the most successful container ports in the world have been those that were purpose built, with deep extensions into adjacent areas where warehouse can be situated.

The net effect was a decline of some ports around the world and the rise of others. At the Port of San Francisco, where the first army containers left for Korea, the former piers used for loading and unloading were no longer required, but there was little room to build the vast holding lots needed for container transport. As a result, the Port of San Francisco virtually ceased to function as a major commercial port, but the neighboring port of Oakland emerged as the second largest on the US West Coast. A similar situation occurred in New York, where Brooklyn and Manhattan docks gave way to new facilities in New Jersey. In Britain, the Port of London and Port of Liverpool declined in importance, while Felixstowe is now one of Europe's largest container ports.

Of course, the great change in container ports has happened in China, where there is nowhere on earth a more illustrative case of the leverage of government funding. China has built new ports for all three shipping segments, but container shipping has been both the primary focus and the clear success story. Shanghai, the largest in the world now, has multiple container ports, all built from ground up. The largest and newest is Yangshan Deep Water Port, which sits 32 kilometers

out to sea. It was constructed because the older ports along the Yangtze and Huangpu Rivers, on which Shanghai had relied for generations, had a maximum depth of 7 meters and silted up regularly. Yangshan, which has been built in four phases since 2000, is one of China's largest infrastructure projects and has been estimated to cost more than \$12 billion. It is 15 meters deep because it sits amid a cluster of islands far out in the East China Sea. For cargo to reach the Yangshan by land the government constructed a six-lane bridge 32 kilometers long — one of the world's longest bridges. The bridge alone took two and half years to build with 6,000 full-time workers.

The second great element in containerization is, of course, container ships themselves. Container ships eliminate the individual hatches, holds and dividers of the traditional general cargo vessels. The hull of a typical container ship is a huge warehouse divided into cells by vertical guide rails, which hold the containers. Shipping containers are usually made of steel, but other materials like aluminum, fiberglass or plywood are also used, and the diversity of container applications is rapidly increasing.

Like supertankers and massive ore carriers, the size of which they have grown to rival, large container ships create economies of scale. The value of the former, both to their owners and the world economy, depends on the value of the commodities they carry. Ore carriers, and dry-bulk ships in general, have been a relatively small and marginalized part of world shipping until the early 2000s. Their spectacular rise in importance is due entirely to China's rise in steel production. Whether this continues remains to be seen, but the current fleet has very little long-term residual value.

In contrast, container ships have a broader impact on the world economy because they are the carriers of the world's intermediate and manufactured goods, and by far, carry the most valuable cargos in the world. Tankers and dry-bulk carriers operate upstream in the global value chains, whereas container ships occupy a variety of functional niches — including more and more, some of the commodities the others carry now.

Container ships in large part, therefore, define where the world's economic output can and cannot be shipped. Building larger and larger ships, as the trend has been in the past 15 years, brings economies of scale, but limits destinations to major ports. For example, the Maersk E-class can carry 15,000 boxes. It can hold 746 million bananas, one for every European. But they are built for the Europe-Asia trade and for a pace of service provision on that route, and cannot be handled in Western Hemisphere ports, which are too small. Ever larger ships bring fixed costs, which enormous financial risk, therefore, on the downside of the shipping cycle, which is precisely what has happened since 2008.

With many finished and intermediate goods, the makeup and cost factors of

supply chains and value chains of the same product or equivalent product can differ widely by region and, therefore, by route, rate and frequency of service. This is one reason why the generalization of value chains has such limited value. The light bulbs Philips sells in Europe and General Electric sells in the US have widely different supply and demand chains. While it may seem at first glance that larger container ships lead to greater profits through economies of scale, manufactured goods are far more sensitive to the number and quality of liner services and to freight rates than cost/per ton mile measures.

This has reduced shipping times between ports to a great extent, but it has also defined ports and routes since containers can only load and unload in suitable ports. They are one of the primary factors tending, paradoxically, to narrow the number of major trading destinations while expanding the global distance between them. Thus, container shipping imposes a new geography on transport. They have the dual effect of enabling the exchange of goods among more nation states, but the high cost of parallel port infrastructure and intermodal connections, tends to reduce the number of trading nodes.

Moreover, the location of final assembly makes manufactured goods doubly route-sensitive: both to route and to the specific leg of the route. The Asia-US routes are illustrative. Because much of final production of the US-retailed goods has been in the Orient, the Eastbound leg of the route is much more time-sensitive in many sectors than the Westbound leg. This is because the US markets connected with dense intermodal networks good enough to make direct factory to storefront connections, especially in the retail computers and electronic and clothing sectors, and in other most other retail sectors factory to warehouse connections. Inventory control is possible at a very finely tuned level, placing a premium on liner services, which translates to more ships on the routes. In Europe, where intermodal connection is much more limited, time to market often matters less than cost to market. The greater the interconnectivity from factory to consumer, the more the value chain turns on virtual considerations and less on physicality.

Added to the enormous increase in the world population predicted by mid-century and centered on less than 30 megacities worldwide, containerization may well lead to the creation of great “mega-hubs” which compete for access to hinterland markets. If so, it will be the “spokes” of the hubs — direct access to the consumer markets — that will make create the competitive edge. Such a trend would place a premium on any technology or infrastructure, real or virtual that defined access to the consumer, all long-distance logistics costs held relatively equal by a mega-hub system. For all of the ink spilt on the rise of global logistics, especially shipping, in the past 15 years, therefore, the less obvious but more important trend in transport may be regional. Global trade, ultimately, is about local consumption.

In such a world, competitive strategies favor entrepôt enterprises, which become intermediary magnets to attract the distant “long-trade” such as Singapore has pioneered, in which fortuitous geography is leveraged by legal and tax accommodations. Given the necessity for new technology, real and virtual, to create both the hubs and spokes, real estate takes on a new importance. Older, established ports may prove more expensive to upgrade than new ports and hubs purpose-built. Future hubs, especially intermediate hubs, are likely to be where today’s ports are not and where tomorrow’s population portends new consumers. Favorable geography opens to areas of increasing population and market growth.

Competition for long-trade — in the shipping industry — is being determined today as the existing major shipping companies and financial backers are struggling to create alliances in a prolonged shipping collapse from the last 15 years of unprecedented growth.

CARGOS

Iron Ore

Iron ore is used as a raw material for the production of steel along with limestone and coking coal. Steel is the most important construction and engineering material in the world. The main importer is China, followed by being Japan and South Korea, with the EU as a distant fourth. By far, the main exporters of iron ore are Australia and Brazil.

Coking Coal

Coal is an abundant commodity. At current production rates, coal reserves would provide approximately 200 years of supply, compared with 41 years for oil and 67 years for natural gas.

In addition, coal is mined in more than 50 countries with no world dependence in any one region. Coking (metallurgical) coal is a high-grade coal with low contaminants, which is used to produce coke to feed blast furnaces in the production of steel.

An increase in seaborne transportation of coking coal has been primarily driven by an increase in steel production. The increase in import activity has occurred in a number of regions. Currently, Asia is the largest major importer of coking coal. Australia and Indonesia provide a significant amount of coking coal to Asia, while South Africa and the United States are major sources for Western Europe. One of the largest sources of coking coal is at Tavan Tolgoi in the southern Gobi Desert, but Mongolia is struggling to mine it. In 2013, Mongolia offered foreign infrastructure equity in return for investment in the site.

Steel Products

Major importers of steel products are China, the US and South East Asia. Major exporters of steel products are Japan, Russia and Western Europe. Both Handymax and Handysize vessels are used for transporting steel products for transoceanic routes and for shorter routes involving intra-Asian and intra-European trades.

Steam Coal

Steam coal is primarily used for power generation. Throughout the 2000s, when oil prices were higher a number of developing countries built power plants that utilize coal, which create significant growth in the steam coal trade. The most dramatic export growth has occurred in Indonesia. China is a major importer, and Australia is the largest exporter. Asian coal is primarily traded in Capesize and Panamax tonnage. European countries tend to import steam coal from exporters in the Atlantic region using Panamax vessels.

Grain

Grains include wheat, coarse grains (corn, barley, oats, rye and sorghum) and oil seeds extracted from different crops such as soybeans and cottonseeds. In general, wheat is used for human consumption, while coarse grains are used as feed for livestock. Oil seeds are used to manufacture vegetable oil for human consumption or for industrial use, while their protein-rich residue is used as a raw material in animal feed.

Grain production is dominated by the US, with Argentina, followed by Canada and Australia. In terms of imports, the Asia/Pacific region (excluding Japan) ranks first, followed by Latin America, Africa and the Middle East. The principal vessel classes used in the grain trade are Panamax and Handymax.

Minor Bulks

Over the past decade, seaborne transportation of forest products has increased by moderately, with South American increasing its exports. The largest importers of wood products are China and Japan. Handymax and Handysize vessels are the primary carriers. The balance of dry-bulk trade is represented by agricultural cargoes, bauxite and alumina, fertilizers and cement. Minor bulks are typically transported by smaller vessels of less than 40,000 deadweight tonnage.

STRATEGIC CONSIDERATIONS

IRON WARS

Along with credit, oil and gas, all global value chains have their roots in steel. While the rise of container ships has garnered much of the popular media and academic writing over the past years, those ships are but one part of a much larger story in transport. Container ships come at near the ends of the economic journeys across the world's oceans, hauling intermediate and finished goods created up the value chain. At the other end, globalization brought about another revolutionary change in the ownership, material flow, and transport of all commodities.

But the big story in commodities has been in iron ore, which has fueled China's rise to become the world's largest steel producer. That story begins in the 1960s with the discovery of vast iron deposits in two of the most remote areas of the world, and leads to the consolidation of those riches during the following decades into the hands of three large conglomerates, who built the world's longest railroads and stupendous ships to transport the ore to China. By 2014, these events have brought the world to the precipice of another global crisis.

Steel production is one of the heaviest industrial enterprises, and in the pre-globalized world, no nation could develop a thriving economy without a steel industry as a bedrock: railways, automobiles, shipyards, buildings, and nearly all else depends on steel. Until the early 1980s, the developed nations in Europe and both Americas met their steel needs regionally both in production and in iron ore. The previous decade, however, was one of prolonged economic slowdown around the world following the OPEC oil embargo. Steel production languished in the recessions, while labor costs and increasingly obsolescent mills dug into what little profit could be had.

Then, with seeming suddenness, the Japanese auto-industry arrived to hack off large chunks of American and European market share. After more than 30 years of effort, the reconstruction of post-war Japan at last was complete, and the heavy industrial family-owned zaibatsu, especially Mitsubishi, Mitsui, Sumitomo, Kawasaki, and Nissan had risen from the ashes, climbing on the back of Japan's new steel production infrastructure.

To create it, what Japan needed was exactly what it had gone to war in part for: oil and industrial materials, few of which are found on its islands. Iron ore, in particular, was needed to make steel, and lacking any, Japan turned to Australia.

In the early years after the war, Australia embargoed its iron supply under the mistaken impression it was limited. But exploration of the Pilbara region in the late 1950s revealed a bonanza of minerals. Pilbara contains some of the world's

oldest surface rocks, more than three billion years old. Geologically, it is known as the Pilbara Craton, once part of the planet's first supercontinent, Vaalbara, broken apart some 2,5 billion years ago. Another piece of Vaalbara lies across the Indian Ocean as the Kaapvaal Craton in southern Africa, where first diamond "pipes" were discovered. Pilbara is rich with petroleum, natural gas, and a variety of minerals. Some 500 commercial mineral projects, 1,000 mining operations, and more than 60 operating oil and gas fields are in Pilbara. It is also the largest commercial iron ore area in the world, second only to Brazil.

Until the recent purchase of shares in the Karara mine by China, the vast majority of the iron deposits are owned by three companies: Rio Tinto, BHP Billiton, and Fortescue Metals Group. The big two producers, Rio Tinto and BHP Billiton, account for the largest production, but the iron ore business has been unstable since the 2008 collapse, and this is likely to be a moving target. Rio Tinto operates twelve iron ore mines, and BHP Billiton seven. The world's longest and heaviest trains roll from their mines to specially constructed deep-water ore ports at Port Hedland, Dampier and Cape Lambert.

In 2013, BHP Billiton remained the world's largest publicly traded mining conglomerate. With a market cap of more than \$330 billion, it owned a very substantial proportion of the planet's long-life, low-cost, export-oriented, expandable mining assets, including aluminum, coal, copper, iron ore, oil, gas, nickel, uranium, and silver. Many of these are effectively irreplaceable, with low sovereign risk and proximity to key Asian markets. BHP has the wherewithal to weather the boom-and-bust cycles of the volatile commodity markets because geographic and product diversification give BHP more stable cash flow and lower operating risk than most of its mining peers. Most revenue comes from the relative safe havens of Australia/New Zealand, North America, and Europe.

Rio Tinto is only a third of the latter's size, but behind Brazil's Vale, it is the world's third largest producer, and has been a frequent target for hostile takeovers. A British-Australian multinational metals and mining corporation with headquarters in London, Rio Tinto has been targeted multiple times for buyouts and takeovers. Since its founding in 1873 in Spain, the company has grown through a long series of mergers and acquisitions in the production of many commodities, including aluminum, iron ore, copper, uranium, coal, and diamonds.

The marriage between Japan's new economy and Australia's iron ore was made in 1969 when the *Osumi Muru* loaded its first iron ore shipment at Port Hedland, 27 years after the Japanese navy bombed the tiny port.

For decades the iron-ore trade was boring, but stable. Annual contracts, predominantly made between Japanese steelmakers and Australian miners, left little room for the price volatility that plagued other commodities such as oil. Profit margins for iron-ore miners were thin, even if relatively consistent compared

to other metals. Thus, Japan's tenure as dominant market player in the second half of the twentieth century was marked by a gradual evolution of the shipping pricing regime, much of it under Japanese control.

In stark contrast, China's impact on the shipping market has been much more concentrated in time, with an absence of long-term planning and coordination between the Chinese steelmakers and ship owners or operators.

Meanwhile, China did not bring its war to a close until the Communists were able to send the Nationalists packing to Taiwan. Unlike the rest of the world, it had been occupied and at war for almost two decades. When the smoke at last drifted off, the blast furnaces and heavy machinery of the only modern steel mill that had existed in the country, built by the Japanese at Anshan, had been destroyed or carted off by the Soviet Red Army during its occupation. Today Anshan is the site of China's second largest steel company.

Steel became the cornerstone of Mao's Great Leap Forward, and steel production grew steadily throughout the 1950s using Soviet designed blast and open hearth furnaces. In the countryside, great numbers of backyard furnaces produced poor-quality pig iron to feed the many small steel plants that were growing. Only 10 years into the revolution, the system broke down in 1961, producing less than half that of the year before. China began again with European and Japanese furnaces, only to fail again in 1967. But Mao prevailed, and the same grass roots system was rebuilt during the Cultural Revolution. Slowly, however, production began to rise, until at his death in 1976, output reached 30 million tons annually from more than 2,000 small foundries and mills. By 1986, after his successors embarked upon a renovation program, China had risen to become the world's fifth-largest producer, but quality was notoriously poor, and the steel it made was used largely for internal infrastructure.

Mao's successors, unable to bring the steel fiefdoms to rule, began to build its first integrated steel complex from ground up, the Baoshan Iron and Steel Works in Shanghai, completed in 1988. Meanwhile, as new technologies were imported and experience was gained, China's output increased and improved in quality. Nonetheless, much of China's industrial growth in the 1990s occurred through the import of high-quality steel, two-thirds of it from Japan. By 1996, China's annual crude steel output was 100 million tones, and then, 123 million in 1993, increasing year by year until 2003, when China overtook Japan to become the world's largest steel producer. Today, China produces half of the world's steel output.

Moreover, China's steel production has risen dramatically in the past five years in response to stimulus policies that have spurred steel mills to massively expand output. Steel companies have racked up large amounts of debt to stay afloat. In 2013 and 2014, Beijing pledged repeatedly to tackle overcapacity, but production continues to increase quarter after quarter, in large part because local governments

are reluctant to close down steel mills, as it could increase regional unemployment.

The numbers tell the story. According to the state-run China Iron and Steel Association, production capacity has grown by an astonishing 200 million tons since late 2012 reaching 1 billion tons per year capacity. This is almost certainly an exaggerated number, but more conservative estimates are still around 800 million tons. The Baoshan complex today produces more than 30 million tons of steel by itself. By contrast, the entire US steel industry produced only 87 million tons in 2013.

Steel exports are growing because domestic steel prices are dropping and domestic consumption is less than a third what China produces. With their profitability remaining the lowest globally, it is possible that Chinese companies will continue to operate even after posting losses, flooding the steel export markets with low-cost steel.

China's steel problems are beginning to appear to have spillover into its banking. Two of the country's major steel companies, state-owned Sinosteel and steel transporter Anhui Wanjiang Logistics have announced their inability to pay back large loans.

At the same time, amid signs of China's economy slowing down and bad bank loans, the government has begun a crackdown on stockpiles of iron ore at ports, which it said is being used by shipbuilding and steel concerns as collateral for borrowing from overseas, thereby allowing the companies to avoid central government capital controls and higher interest rates. Some estimates are that as much as 40 percent of the iron ore sitting at Chinese ports is being used as collateral. Investment bank Goldman Sachs estimates \$100 billion has been borrowed in this way since 2010. This is one reason the iron ore spot price has fallen more than 30 per cent since the start of the year — the fraud allegations continue to crop up.

Case: Stockpiling in China

In June 2014, China's state-owned Citic Resources Holdings Ltd announced a press statement that it could not locate more than half of its alumina supplies it had stored at Qingdao, and that it had applied to a local court for help. Citic said 123,446 tons of alumina had somehow gone walkabout, from a total stash of about 225,000 tons.

The statement came after China's national government had announced intention to investigate fraud in China involving imported metals that were used as collateral for loans, while using domestic aluminum to cover production. Banks have lent hundreds of millions of dollars to Chinese commodities traders in recent years, using commodities such as copper, iron ore and aluminum as collateral.

Recently, in an effort to control the practice, customs officials have begun to slow roll approval of copper and iron moving through ports, doubling the days to clear shipments.

All of this has occurred during an unprecedented run up in iron ore prices in the past 15 years, following by a precipitous crash that is showing no signs of stopping. Into this cauldron, we may now move the story to Brazil.

In 1967, a helicopter carrying a team of geologists ran out of fuel and was forced to land in a clearing in the remote region of Carajás in northeastern Brazil. There they discovered by accident 18 billion tons of the world's highest grade iron ore, and not a small amount of gold, manganese, copper, and nickel. The discovering geologists worked for the US Steel Corporation, which attempted to take the land over from the Brazilian government. Brazil refused, but entered a partnership with the US firm owning 49 percent, and the sovereign corporation Vale owning the controlling interest. The US Steel was forced out quickly, and Vale took over the mine, as well as nearly all of Brazil's mines in the ensuing decades. Vale grew into one of the largest logistics operators in the Western Hemisphere and emerged as the world's largest producer of iron ore, pellets, and second largest of nickel. Vale also produces manganese, ferroalloys, copper, bauxite, potash, kaolin, alumina and aluminum. In the electric energy sector, the company participates in consortia and currently operates nine hydroelectric plants.

But iron prices languished until China's emergence, and in 2000, Vale saw its opportunity. Carajás, Vale's crown jewel, is one of the highest-quality and lowest-cost iron ore operations in the world. The quality of its iron ore allows Vale to command a premium in the marketplace. Vale invested heavily in truckless mining, and efficient processing, as well as the pivotal rail and port infrastructure needed to transport materials to the seaborne market, where the company makes the overwhelming majority of its sales. The only problem was Carajás is on the eastern shore of Atlantic Ocean, and China on the western shore of the Pacific. Its Australian competitors, on the other hand, were but a comparative stone's throw away.

As Vale struggled with the Australian rivals Rio Tinto, BHP Billiton, and Fortescue two strategies emerged. One was to lower the costs of its ore production, especially at Carajás, Vale's crown jewel. Carajás ore already commanded a higher price per ton than Australian, Indian and native Chinese ore since it has higher iron content, as well as lower alumina and silica impurities, Vale saw that if it could lower its production cost as well, its price differential might begin to make up for the shipping penalty inherent in its distance from the Far East. As a result, throughout the decade of the 2000s, Vale invested heavily in production technology.

The other element of its strategy was to build a stupendous class of ore carriers,

which they called Chinamax. With a capacity ranging from 380,000 to 400,000 deadweight tonnage, these were ships far larger than competing Capemax vessels, though they had the drawback that their great weight and draft would limit them to entering only a few deepwater ports worldwide. To make sure they would gain Chinese and South Korean approval for the ships, Vale placed orders for 24 of the class to be built in Chinese yards and another 12 in South Korean yards. The last ship orders were placed in 2008 just before the stock market collapse, but could not rescind the contracts.

Ships continued to be delivered until the last was completed in 2011, after sharp drops in the iron ore market. Even though they were designed for the Far East trade, the Valemax's were met with mounting criticism by other shipping companies in its own hemisphere. Industry estimates were that the Valemax ships could cut the company's transportation costs by as much as 25 percent, and the Valemax's were blamed for driving down the freight rates for the entire industry, swelling the already oversupplied bulk transportation market and stalling the recovery of the shipping business.

Vale's troubles mounted as its stock plummeted. Shortly after the first deliveries, one of the ships, Vale Beijing, suffered structural damage while being loaded in Ponta da Madeira (Brazil), and had to be towed away from the loading piers to anchorage amid fears she would sink and block the facility. This provided the opportunity for a Chinese shipping rival to successfully lobby its government to prohibit Valemax ships from China's ports as the iron market remained unstable.

Amid other reactions, no doubt, Vale's executives renamed the ship class Valemax, and began to scramble for solutions.

An on-again, off-again drama ensued in which the Chinese government seemed to waffle on its decisions, allowing two to land over the next two years. But meanwhile, Vale was taking delivery on ships and had bills to pay quickly.

One set of options was to add transshipment points for its ore in Subic Bay, Philippines, once the principal naval base for the US in the Pacific. A second hub is under construction at Teluk Rubiah in Malaysia. But transshipment was at best an unsatisfactory bandage, one that added costs though it gave the ships landing. This was accomplished quickly, as more and more VALEMAXs were slipping off the ways from the shipyards.

In mid-2014, Vale seemed to have succeeded by largely unspecified arrangements in changing China's mind. Part of the deal that was made public was that China's shipyards would get the orders for new ships.

Vale may have survived only because of its ownership — it is a privatized Brazilian corporation, the majority holdings of which are still estimated to be government-owned or controlled through a complex financial structure, including foreign incorporation in the Cayman Islands, one of the world's largest tax havens.

In the fourth quarter of 2014, two further developments occurred to add to the drama:

1. In Brazil's presidential elections were held amidst a sluggish domestic economy there, in which Vale's stock and that of the country's largest industries have dropped through the floor. The incumbent Dilma Rousseff, widely seen as a populist, not a business advocate won in the closest election in Brazil's history, sending Brazilian markets down 5 percent the day afterward, and plunging the Brazilian real by 9 percent to its weakest level since 2005. The state-run oil company Petrobras lost 13 percent, and bank shares fell between 4 and 6 percent overnight, and Vale shares fell another 5 percent.
2. Second, as iron ore prices dropped to the lowest in nearly two years, all three major producers announced they would increase production, not decrease it. Several smaller iron ore producers have filed for bankruptcy protection, as the big three's increase in production further depressed prices. Finally, by the end of October, China announced it would cut its domestic iron production, in a move counter to the three large importers.

However the iron wars shake out, the outcome will have great impact on the global economy in general and on the shipping industry specifically. Making steel requires not just iron ore, but also coal — the second largest dry bulk carried commodity. The impact on shipbuilding can be expected as severe in an already depressed segment of the industry. The economies of Brazil and Australia, both of which have come to rely on iron ore exports for their economies, ride on the balance.

In the case of Brazil, a failure to sustain sales to China, would reduce not only its prices, but its remaining economic strategies. Unless a new steel behemoth arises in Africa or the Americas, Vale must steam the long path to the Far East, while Rio Tinto and BHP enjoy the shorter one. In a more complicated situation, India may find it cannot take the same path to development as China and Japan once did. This may have long-term ramifications for India and for Southern Asia.

In North America, where the service industry has long replaced manufacturing as the key component of its economy, the impact is likely to be less problematic. In Europe, the impact of a long-term depression in steel prices would have a significant impact on ArcelorMittal, as the prolonged recovery has already shown. Formed in 2006 via the merger of Arcelor and Mittal Steel, the two largest steelmakers at the time, ArcelorMittal now produces more than 6 percent of the world's steel. While the company is reported to drive the majority of its revenue from North

America and Europe, emerging markets account for approximately 40 percent of the company's total sales.

Case: Fortescue Follows Vale's Example

Mineral Oak typifies the complexity of ship operations. Leased to the Australian mining company, Fortescue Metals Group Ltd is the fourth largest iron ore producer in the world and the largest holder of iron tenements in Australia, more than 87,000 square kilometers. Fortescue's largest Pilbara mines are Cloud Break Mine and Christmas Creek, which produces about 90 million tons of iron ore a year. Christmas Creek is operated by another Australian company, Macmahon Holdings. The mines are connected Port Hedland by Fortescue's private 280 kilometers railway.

As iron ore prices dropped through the floor in 2014, Fortescue found itself in a \$7 billion in debt with its competitors — Vale, BHP Billiton, and Rio Tinto — all increased iron production, dropping the price even more. Meanwhile, Vale's new fleet of VALEMAX carriers were allowed into China's ports, sharply decreasing Vales shipping costs. To compete, Fortescue decided to ramp up production as well, and to cut costs, it would build its own fleet of eight new very large ore carriers (VLOC) from an unspecified Chinese shipyard at a \$250,000 each. Even so, the company said, the new ships would only provide about 12 percent of its needs.

Mineral Oak and ships like her, though, much smaller will fill the remaining need. Built in 2010, at Waigaoqiao shipyard in Shanghai, she is a 177,000 deadweight tonnage and has been hauling Fortescue's ore from Port Hedland to the Chinese ore port of Qingdao for several years.

Mineral Oak is listed as owned by Antwerp-based Bocimar International, which in turn is owned by the CMB Group (Compagnie Maritime Belge) (CMB). CMB's origins reach back to King Leopold II, who had gotten the approval of the royal houses of Europe to claim the Congo as a colony, and had immediate need of a shipping line. In the wings was a 30-year old entrepreneur, Felix Saverys, who came to own Compagnie Belge Maritime du Congo. The Saverys family owns CMB still. Bocimar is the CMB company that deals in dry bulk ships. Mineral Oak appears to be partly owned by Oak Maritime Group of Taiwan. Oak Maritime's roots go to Sincere Navigation Corporation, which is a publicly-owned company based in Taiwan that has subsidiaries Norley Corporation and Heywood Limited, which flag other vessels in Liberia and the Marshall Islands.

Chapter 3

Extended Value Chain

HOW THE BUSINESS OPERATES

Certainly the mechanics of the shipping business is in the hauling of freight, but profit in shipping turns on many other factors, some very distant from the sea itself. In general, shipping strategies focus on gaining advantage on the right route at the right time, creating leveraged position, and wherever possible, squeezing out competition. The financialization of shipping makes one of the most critical factors timing the movement of supply and demand in freight capacity — the ups and downs of which are known as the shipping cycle — correctly. Those who get it right make quick profits; those who do not can go bankrupt quickly. In a capital-intensive business such as shipping, second chances rarely come around. Long-trend shipping statistics show this clearly, as decade by decade the number of firms fall off the exchanges, merge with others, or struggle in between with alliances.

Financially, the shipping industry, as we observed in the earlier section on perspectives of maritime trade, is centered on the concept of recurring shipping cycles. It operates through four markets: the freight market, the sales and purchase market, the shipbuilding market and the demolition market.

THE SHIPPING CYCLE

As in larger financial markets, the shipping cycle is an economic concept used to capture the overall movement of supply and demand for the maritime services in the economy at large. And as with all futures markets, perception of an impending change in the shipping cycle can be as great or even greater than actual changes.

The starting and ending point of shipping booms is less about the shipping trade, per se, than the economy at large. A shipping boom begins in response to after a developing economic boom becomes clear enough to invite risk, and collapses suddenly once an economic bust is clear. In between, there is a solid coupling in the cycle with shipping itself. Risk accumulates slowly as investment

in ships and infrastructure grows during the boom. The natural tendency, once committed is to linger too long past the point of economic crisis, either in the hope the harbingers of collapse are wrong, or in attempting to maneuver on the downside.

Generalized, the cycle has four stages, which are only clear in hindsight: a bottom, a rising recovery, and a peak, followed by a collapse. The starting and ending point of shipping booms is less about the shipping trade, per se, than the economy at large. A shipping boom begins in response to after a developing economic boom becomes clear enough to invite risk, and collapses suddenly once an economic bust is clear. In between, there is a solid coupling in the cycle with shipping itself. Risk accumulates slowly as investment in ships and infrastructure grows during the boom. The natural tendency, once committed is to linger too long past the point of economic crisis, either in the hope the harbingers of collapse are wrong, or in attempting to maneuver on the downside.

Over the past four decades, shipping cycles have been relatively monolithic. One sign of sure change in the industry can be seen when different segments and different routes react differently, particularly as they have since 2008:

- The tanker business is struggling because oil prices are declining from new sources of crude, more than a slowdown of the economy, which in the US and the Far East continues at a substantial rate of recovery, and because fundamental route changes are occurring as the US backs away from imports. Neither of these are hitched to the economy at large, but rather reflect changes in the commodity itself.
- Similarly, dry bulk shipping in the past decade was driven to stellar rates almost entirely by iron ore and coal transport, which were the result of China's rise to a developing nation and steel output in support of that rise, not because of a downturn in economic cycle. China's steel production may or may not continue. There is as much reason to see that as continuing as not, but it is not a previous cyclical trend.
- At the same time, while container shipping has clearly declined as a result of the 2008 crash, the entire thrust of globalization has been to move intermediate and manufactured goods around the world as part of an overall production process, which is not a pattern seen previously in history. There is no more reason to believe any of the container routes will continue than to believe they will not. *Freight routes today reflect not only pathways in manufacturing, they also contain much trade between transnationals and their subsidiaries. If the trend world output continues to be in consumer goods, then we*

should expect that both downstream and upstream, ports of origin and destination will change as the developing economies mature. This is one of the cardinal differences between world trade today from past decades. Container ships are shuttling back and forth inside the value chains more than in trade of finished goods.

At the bottom of a shipping cycle, freight rates can drop to levels that force ships to lay-up, and if the trough lasts long enough, foreclosures on ship notes ensure.

This has been the case recently. As shipping bottomed out after the 2008 collapse, in Europe that crisis was followed immediately by the EU debt crisis, which came to boil 2010. Ship loans are a major part of overall EU bank loan portfolios, and by 2012-2013, many banks began to sell of these portfolios to outside investors. Among the buyers were new players in shipping: exchange-traded funds, for whom buying deeply discounted paper debt was a less risky way to get into the shipping business without investing in ships. Among the banks that were heavily laden were Britain's desperately struggling Royal Bank of Scotland and Lloyd's Banking Group. Lloyd's was reporting dumping \$500 million in loans to a US hedge fund, Davidson Kempner Capital. German's Commerzbank and HSH also were reported selling sizable loans.

The announcement in late 2014 that a number of European banks failed central banking stress tests would seem to point to continuing core financial issues, now in a sixth consecutive year.

This situation is illustrative of the points made previously of the value of the invisible elephants nation-state support provides. China's shipping fleet, hit by the same slowdown in freight trade, not only remains unharmed, but is profiting by the European collapse. Nothing could be more fortuitous for China than the loss of European commercial shipping.

THE SHIPPING MARKETS

The imperative to stay on the upswing of the cycle has created distinct markets overtime in the commercial shipping industry. Four are traditionally cited, following approach of Martin Stopford, long a Director of London-based Clarkson, widely considered to be the leading provider of shipping services in the world: the freight market, the sales and purchase market, the shipbuilding market, and the demolition market.

All have been around in one form or another since shipping began. Since 1990, however, as in all financial markets, the freight market has become financialized increasingly in the form of a futures market. In large part, this expansion has occurred through a continually expanding portfolio of financial instruments

introduced by shipbrokers, who have steadily gained expanded the role of the comprador in the industry. Clarkson has led this trend, and both the firm and Stopford have published extensively describing the four markets as an interrelated system, but that view has as much to do with marketing as it does with the markets themselves. Stopford's *Maritime Economics* is the classic text on the markets.

In reality, each of the shipping markets has a somewhat different dynamic, and shipbroking firms are wont to portray themselves as orchestrators of the overall system. In reality, it is the shipbrokers that have created the fabric of the markets, and insofar as the markets operate, they do so through shipbroking houses. Few outside of brokerage houses are active across all four markets. Without question their success has been substantial, and it is in the four markets that the financial underpinning of commercial ships lie.

THE FREIGHT MARKET

The modern freight market has its origins in the 1700s at the height of colonial shipping. In fact, in the intersections of two human needs: drinking coffee and making money. In 1774, London was chock full of coffee houses, but for merchants and sea captains, the place to be was the Virginia and Baltic Coffee House, on London's Threadneedle Street, just a short hike from the Bank of England. There they gathered to discuss the second need, which centered on finding a way to stabilize rampant speculation in the shipping market that was swinging the ship chartering market wildly, with the net result that money was being lost on the whims of worry. An enterprising group rented a room in the coffee house, offering free refreshments to newly arrived sea captains and connecting them to merchants with cargos.

The informality gave way to a sort of price-fixing club, limited to an exclusive membership of 300 members. Those who wanted to ship goods could find a stable, if elevated price, while those who went to sea could find ready cargo for the price of the membership fee. In effect, the coffee house group, which became known as the Baltic Exchange, made money after the classic middle-man fashion of shipping: they were paid for stability of rates, which lowered the high risk of capital investment in ships and cargos. As always one lucrative thing leads to another, and with the advent of the transoceanic telegraphs, captains at sea could cable the Baltic for the whereabouts of a good cargo nearby a port where the ship had just unloaded. Worldwide, staying on the good side of the Baltic Exchange was worth money, and sea captains, merchants, port operators, purchase agents all came to know a good thing.

Today's freight market still has to do with matching ships to cargos, but its main activities are in hiring of ships and in the sale of hedge instruments, which are known as freight derivatives. There are separate markets for different ships in the freight market. The freight

rates for tankers, bulk carriers, container-ships, gas tankers, and chemical tankers behave quite differently, but, as Stopford observes, because it is the same broad group of traders, what happens in one sector eventually ripples through into the others. The freight market has two different types of transactions. Through a freight contract, a shipper buys transport from a shipowner at a fixed price per ton of cargo. Alternatively, through a time charter contract, ships can be hired by the day. Freight contracts have the risk and rewards of fixed price in a moving shipping cycle, while time charters present the opposite.

In order to set the prices for either transaction or all the variants in between, a common basis for cost has to be established, which is the dilemma the originators of the Baltic Exchange resolved to do. There are today multiple indices for different types of cargo and by different routes. Like the economy at large, shipping indicators are composites of various weighted indices. For example, the Baltic Dry Index (BDI) is a number issued daily by the London-based Baltic Exchange to measure the rates for the dry-bulk ships that carry major raw materials, i.e. coal, iron ore, crude oil, and grain. Each day the Baltic Exchange directly contacts a selected set of shipping brokers on the world's major routes to assess price levels for each route. This is done for each of three sizes of ships — Capesize, Supramax and Panamax. The answers are melded into the BDI, which appears in shipping publications such as Lloyd's List and on the screens of information vendors such as Reuters and Bloomberg. The Baltic Exchange is a highly insular group, with 550 members, nearly all of which are in the dry-bulk industry.

In container shipping segment, there is no such a unified index like the BDI; many separate indices are in use. Usually, large consulting and shipbroking firms compile their own indices. Some in common use are: Clarkson-Howe Robinson Index, Harper and Petersen & Co. Harpex, Maersk Broker Container Index, Braemar BOXi Index, and the New Containership Time Charter Assessment Index. Tankers have a variety of indices. One commonly used is the Worldscale Index, which reflects the cost of transporting an oil cargo on each main route using a 12,000 deadweight tonnage tanker.

The other aspect of the freight market is the sale and settlement of freight derivatives. These operate like hedging instruments in all modern markets, through a derivatives contract in which one party take a long position, while another a short position. Freight derivatives come in a variety of instruments and are offered by different firms.

SALES AND PURCHASE MARKET

The most cyclical of the markets is the sales and purchase market, which not only follows general shipping trends, but also the major cargo segments. The annual returns to owning and operating a ship vary massively over time. Dry bulk ships and tankers, are particularly volatile, because their value not only reflects momentary supply and demand of shipping in general, but also the price fluctuations in the commodities.

As an example of volatility, in 2001, a 5-year old Panamax ship commanded daily lease rates of \$5,325 and could be purchased for \$14 million. Six years later at the height of the boom, daily lease rates had grown more than tenfold to \$61,000, and purchase prices had risen more than fivefold to \$89 million. By 2011, however, both lease rates and secondhand prices had nearly returned to their 2001 levels. Like the freight market, the sale and purchase market is affected through shipbrokers.

Of the two remaining markets, new construction and ship demolition, only the former is of interest here, and our focus is on the evolution and devolution of shipyards as an industrial base.

THE ROLE OF INFORMATION

Financialized markets create at least two independent time values for information.

One applies to rapid oscillations in the financial markets, which are driven by the short-term trending and more by the perceptions of data than its ultimate reliability. Short-term rhythms are exceedingly complex in all types of investment today, from the composites of financial indices to the timing of news. Algorithmic trading, growing throughout the world in least regulated financial markets, increases both the number and severity of swings, as well as the potential to tumble into the more regulated markets.

In shipping, historically the variance in short-term financial movements has been attenuated by the relative analytical simplicity of shipping indices, by the comparative paucity of data gathered on freight, by the fact that there are relatively few indices, and that they are produced only by the major industry firms. Thus, shipping appears relatively monolithic compared to other industrial segments. The Baltic Dry Index, for example, is produced daily by a small bank of a telephone canvassers in London who call a selected set of major shipping companies worldwide each morning and provide consolidate their estimates of freight rates on selected world routes. If logistics companies continue to grow in number and sophistication, the amount and precision of data collected in shipping also will increase, as will the analytic techniques used to examine it. This is ongoing today: freight indices

becoming subject to the same mathematical scrutiny that other financial indices have elsewhere in the economy. New and better shipping indices are likely to emerge, having the effect of surfacing more time-sensitive data points than today. In the short-term markets, this may lead to considerable new fragility.

The other time value of information is in long-term planning and investment, which does place a premium on accuracy and veracity of data. This is a multidimensional dilemma that faces all industries, of course. Globalized industries are more complex, both in size and scope, making verifiable data both expensive and difficult to obtain. Moreover, modern technology requires considerable specialized knowledge to understand. Even in open societies, analysts and journalists face formidable challenges on many fronts. Complexity doesn't unravel well in power points and sound bites. The opposite effect occurs: the more a spin is repeated across the internet, the more it becomes accepted truth. There are, too, legions of press agents and public relations professionals that come to work around the world today managing and manufacturing information. In the shipping business, this is made all the more difficult because its fluctuations respond to on distant, largely unverifiable, data. There is the converse as well: globalized value chains are impacted as much by data that is reported as by data that isn't.

SHIPYARDS

In 2008, the shipbuilding industry crashed with extraordinary suddenness. Delivery of ships is time late of orders, so ships on order continue to slip of the ways after the crunch. But by 2010, the trend was clear: the order books were 80 percent below their peak at the height of the shipping cycle in 2007. Despite relatively low new building prices and the prospects of a possible recovery of the shipping markets in the future, ordering activity reached a ten-year-low of 52 million deadweight tonnage in 2012. This volume is 33 per cent lower than during 2011 and equals only one third of the order levels of the boom years 2003-2008 in which average ships with a capacity of 150 million deadweight tonnage have been ordered annually. Roughly one third of the shipbuilding activity in 2013 was still attributable to the order book that had been built up during the boom years. At this writing, in the 3rd and 4th quarter of 2014, the Baltic Dry Index began to rise significantly in response to China's announcement it would allow Valemax vessels into its ports. At the same time, the order book for new building in the dry bulk sector also slightly increased, indicating some faith in that sector, at least of a turnaround.

Still, worldwide ship construction remains in a slump, though with fits and starts over the past six years, and seems stalled. Competition for Valemax may

spur new growth, but only if China's appetite for iron ore continues. Only China's and the US and UK military yards are building significantly, and there is a modest amount of specialized shipping being built. For example, South Korean Daewoo shipyard delivered the platform installation/decommissioning and pipelay vessel Pieter Schelte to the Swiss engineering firm Alseas Group in 2013. A gigantic catamaran, she is unique in design, built to gather up oil rigs at sea and take them into port. On completion, the ship will be 382 meters long and 124 meters wide, and is presently the largest vessel in the world.

Russia continues to lead the world in icebreaker construction, with a new class building at Baltiysky Zavod in St Petersburg that will be able to cut a path in Arctic ice twice the width of present classes. Other countries are also building icebreakers and polar research vessels, but none approaches the Russian effort.

Liquid natural gas (LNG) tankers are a niche business, as is the fuel itself. In 2014, there was a glut on the market of LNG tankers with 134 newbuilds since 2009. It seems clear, however, that selected markets for the gas will grow, especially in the Far East, where Japan partners with Russia in development of the Sakhalin Island offshore production. India's consumption is also rising. South Korea leads construction of LNG tankers, followed by China and Japan.

Like ships themselves, every downturn of the cycle shuts more shipyards down with fewer getting back up when it returns. Ship construction is among the heaviest industries in the modern world. It requires a very large physical infrastructure of steel mills, foundries, machine shops, turning basins, dry docks, cranes and more. Because of this and the labor-intensive nature of the work, since World War II it has been one of the primary stepping stones for rebuilding economies.

Stepwise, Japan, South Korea, and China have used shipbuilding to leverage their economies and as a major job sink for their large populations. An industrial capacity for shipbuilding requires decades to achieve and has been rarely achieved without steady infusions of state funds. One effect has been for the large shipbuilding nations to impose various protectionist legislation to safeguard employment, but around the world, commercial shipyards without subsidy struggle mightily in downturns. As a result, the world shipbuilding market over the long term has always suffered from chronic over-capacities, depressed prices, low profit margins, and widespread subsidization. Protectionism in shipping is centuries old. Adam Smith provided an early economic analysis in "The Wealth of Nations", lamenting: "It has, I am afraid, been too common for vessels to fit out for the sole purpose of catching, not the fish, but the bounty."

Part of the logic for maintaining a national shipbuilding industry is military. Military logic remains very strong in Russia, the US, the UK and China. As the downturn continues, and commercial yards struggle, each of these four countries may emerge with highly capable, industrial shipbuilding intact.

RUSSIAN SHIPBUILDING: REDUX?

Indeed, since the Ukrainian crisis Russian President Vladimir Putin has announced plans to increase its Navy, including the purchases of two small French helicopter carriers and is reportedly considering purchase of Chinese-built frigates. The announcements provide insight into the decayed state not only of its Russia's navy, but also its shipyards. However, since Russia clearly has the financial resources, the declared intent to renew naval efforts, and the need to construct new Arctic shipping if it is to grow the Northern Passage, it is not inconceivable that a shipbuilding capability may rise even in the face of the downturn.

If so, it has a long way to go. During the Soviet era, shipbuilding and design was bureaucratically competitive. At the close of the Cold War, the result was Russian shipbuilding is uneven, and its large surface ship construction resident in the Black Sea yards, now owned by Ukraine. As with the military aircraft, artillery and armor bureaus, when the Soviet Union broke up, it had little immediate value for the Russian oligarchs, who swallowed up other industries under Boris Yeltsin's short reign. Though submarines of brilliant design and skillful execution appeared, only smaller classes of surface ships were successful. Four times over the Soviet period, its Navy attempted to build aircraft carriers and battle forces, which remain the sine qua non today of naval ability to project power ashore.

Merchant shipping was never a Soviet priority, because its sole export of large value was pipelined oil and gas. One exception existed: lacking sea routes and access into Siberia above the Trans-Siberian route, a tiny merchant fleet servicing the Norilsk mines emerged. Nonetheless, it has strong capability for specialized vessels such as icebreakers, and had a small, but growing commercial trade in St Petersburg until the 2008 crash. The Ukrainian Black Sea shipyards have fallen into disrepair since the breakup.

THE US SHIPBUILDING

As with the rest of its merchant infrastructure, the US is an example of an extreme in shipbuilding. Ship construction in the US dominated by military and civil contracts, and heavily subsidized through its large and steady flow of dollars in naval shipping. Only the oil and gas industry and shipping concerns on the Great Lakes are modest exceptions. The US fleet is refreshed by a rolling build program of about 40 or more naval combatants every four-year budget cycle. Its carrier fleet and submarine fleets are being upgraded to new and ever more complex designs that require a workforce of especially skilled shipworkers, particularly in welding, avionics and electronics.

That governments like shipbuilding and see it as part of the national security

industrial base is exemplified in the US and in the UK. A recent report by America's Maritime Administration estimated that more than 107,000 people work in the country's heavily protected shipyards. Adding in the companies supporting the yards, and the shops and services that support these workers, the total ran to 400,000. This makes for a powerful lobby in Congress in addition to the already powerful defense lobby.

THE UK SHIPBUILDING

Between 1977 and the mid-1980s, the British shipbuilding industry, with the exceptions of a few minor yards, was nationalized as the British Shipbuilders Corporation. British Shipbuilders restructured the industry extensively, merging and closing many operations, with the remnants sold off throughout the 1980s. It did not make a comeback. In 2013, even the famous Portsmouth shipyard was announced to be closed, and the UK has outsourced the construction of Royal Navy tankers to South Korea.

It does build Royal Navy ships in its own or allied yard, and sent a half billion pounds of naval construction to Australia, in a tangential effort to capture cheaper Far Eastern labor. Under great uproar at home, and giving the phrase "just in time" a new twist, in the run up to the election on Scottish independence, the Ministry of Defense announced significant new naval construction would move to the Clyde shipyards, bringing 800 new jobs to Scotland. Its two new Queen Elizabeth class aircraft carriers are being built in Scotland as well, though the Ministry of Defense has announced only two will be built and that these would be the last in their fleet.

CONTINENTAL EUROPEAN SHIPBUILDING

In Europe, the recession has cost a number of former crown jewels of the industry and places the remainder at risk. Shipyard closures have occurred throughout Europe and others sold, even as the big three shippers stopped new construction and today are slow steaming their current fleet and creating alliances to weather the crisis. By tonnage, only Romania and Germany rank among the world's major shipbuilding nations, sixth and eight respectively out of ten. The EU is estimated to account for only 1 percent of the world market share by late 2013.

A unique exception is the Trieste-based Italian shipbuilder Fincantieri, which has risen to world class since its establishment in 1959. The company is majority owned by the Italian Strategic Fund, which was established in late 2011 as a state-

backed sovereign fund and is speculated to have an operating balance of 4 billion €. With that backing, Fincantieri, traditionally a cruise ship builder acquired yards throughout Europe, as well as two in Brazil and one in Vietnam as part of its purchase of STX Europe in 2012.

STX Europe had been created by a previous merger of Norwegian-based Aker Yards and the French Alstom shipping company in Saint-Nazaire and in Lorient. Fincantieri renamed STX Europe to Vard Holdings Limited. Vard, which has the oil supply shipbuilding expertise resident in the former Aker Yards, has made the Italian government, through its ownership of Fincantieri, the largest shipbuilding concern in Europe by far. As the Italian economy sinks lower amid concerns about its debt, the ownership of Europe's shipbuilding assets places great pressure on the EU at large to bail Italy out should it undergo defaults. Fincantieri's ability to compete with Far Eastern yards is heavily in doubt, given highly organized EU unions, and if it does, its market share will be small. Nonetheless, strategically, the Italian firm now holds all of the EU's shipbuilding capacity in its grip.

FAR EASTERN SHIPBUILDING

The net effect of the recent shipbuilding boom has been to push nearly all the world's largest merchant ship construction to the Far East, where by 2012, China overtook South Korea as the world's largest shipbuilder. Current estimates are that China constructs as much as 45 percent of new ship construction worldwide, with South Korea building 29 percent, and Japan 19 percent.

China's gain, however, reflects considerable construction of its own fleet and little of that has been in construction of more specialized, high-value construction, which requires technical skill in abundance, both in engineering and in the trades. That skill is resident in South Korea and Japan.

Moreover, throughout 2014, as the Chinese economy was showing signs of cooling off, the government undertook a number of steps to curtail overbuilding. In part, this is a larger effort over the past decade on the part of the national government to gain control over its heaviest industries. Special targets are the steel and the shipping industries, a majority of which are state-owned but managed bureaucratically by regions. In particular, China's two largest shipbuilding conglomerates, the China Shipbuilding Industry Corporation (CSIC) and the China State Shipbuilding Corporation (CSSC) are powerful fiefdoms. CSIC handles shipbuilding activities in the north and the west of China, while the China State Shipbuilding Corporation (CSSC) deals with those in the east and the south of the country. Both have subsidiaries listed on the Shanghai Stock Exchange, giving them the chameleon-like power to be both state subsidized and privately invested.

In 2013, China won 39,5 percent of global orders in the first half of the year while South Korea garnered 36,5 percent. State-owned yards won almost three-quarters of those deals, in great part because they are at an advantage due to their easier access to credit terms for raw materials and new vessels financing. In March 2014, Reuters reported that the China Banking and Regulatory Commission had ordered banks to report on outstanding loans in the aluminum, steel, cement, flat-glass, and shipbuilding sectors.

In September 2014, another round of announcements were made about bank loans to its largest shipbuilding and steel companies. China's state-owned banks were ordered to sell off non-performing loans to its "bad bank" system, set up to take nonperforming loans off the books of the major state-owned banks. Several major banks then announced they expected bad loans to continue rising this year, especially from creditors in the steel, wholesale and shipping sectors. On September 28, the Agricultural Bank of China said it had cut loans to customers in steelmaking and shipbuilding by almost 39 billion yuan. Yet, the situation is complex: these industries are at the core of China's rise. They have created much personal wealth in doing so, and with that wealth, will surely come influence. Whether China's national government can rein in its heavy industries remains to be seen, especially in light of its naval buildup, which has created additional power structures for Beijing to deal with.

South Korea

South Korea continues to dominate the market for building large vessels such as super tankers, LNG carriers, drill ships, and large container ships. South Korea's shipyards are highly efficient, with the world's largest shipyard in Ulsan operated by Hyundai Heavy Industries, which claims it slips a newly built, \$80 million vessel into the water every four working days. After its loss to Chinese yards, Hyundai made major changes in management, bringing in executives from its oil segments.

South Korea's "big three" shipbuilders, Hyundai Heavy Industries, Samsung Heavy Industries, and Daewoo Shipbuilding & Marine Engineering, dominate global shipbuilding, by every measure save total tonnage. Four more yards, STX Shipbuilding, Hyundai Samho Heavy Industries, Hanjin Heavy Industries, and Sungdong Shipbuilding & Marine Engineering, also ranking among the top ten shipbuilders in the world.

LINES OF COMMUNICATION

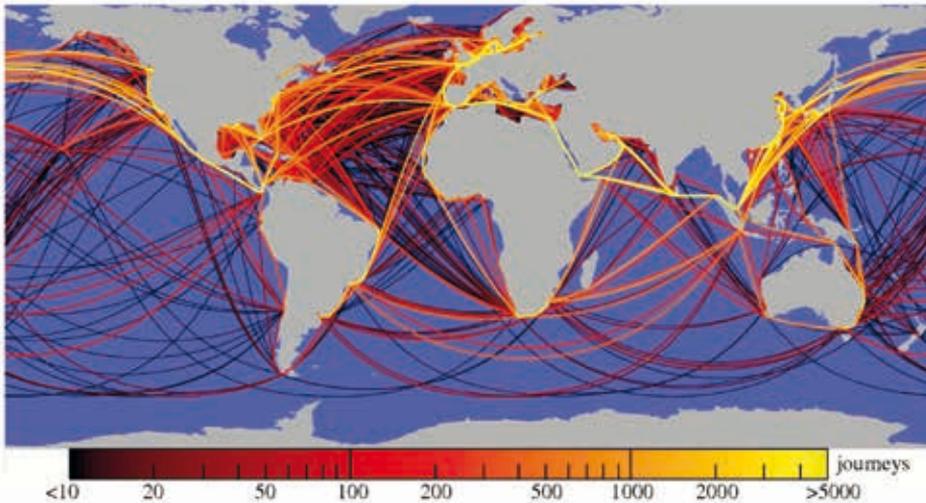


Figure 6. All merchant shipping vessel tracks (GPS data 2009).

PANAMA CANAL

Opened in 1914 after 10 years of struggle with terrain and yellow fever, at a staggering cost in today's dollars of more than \$8,5 trillion, the Panama Canal saves almost 8,000 miles on a trip from New York to San Francisco from the treacherous passages at the southern tip of South America. Although merchant traffic profited from the canal, the impetus for its construction was almost completely strategic. Without it, the coal-fired US naval fleet, headquartered on the Atlantic, could not move quickly into the Pacific Ocean, where the US territories of Hawaii, Samoa, and the Philippines lay.

From 1904 until returned to Panama in 1999, the US controlled five miles of land along either side of the canal. In 1964 riots over sovereignty of the Canal Zone broke out in Panama City and unrest continued. In 1977, the US signed a new treaty, promised to withdraw from the Canal Zone by the end of 1999 and guaranteed that Panama would assume full sovereignty over the area in 2000. Under the treaty, Panama became obliged to guarantee the neutrality of the Canal Zone. Since then, although the canal is sovereign Panamanian territory, increasingly it has come under Chinese influence, as trade between Latin America and China has rapidly expanded.

In 1996, in preparation for the canal's return, Panama decided to auction the rights to manage the canal to a private company. Amid charges of bribery, and despite being fourth in its bid behind Japanese, American, and Panamanian companies, the following year Panama awarded the contract to the Panama Ports Company, a subsidiary of Hutchison Whampoa Ltd, which now has exclusive and extensive rights to control both ends of the Panama Canal. Hutchison Whampoa is a Chinese company owned by Hong Kong billionaire, Li Ka-Shing, who has strong ties with Beijing. Under the legislation that implemented the contract, Panama granted to Hutchison Whampoa the ports at both ends of the canal, and the surrounding areas the US used to control, including the former US naval station and air base for 25 years with an automatic renewal for another 25 years.

The canal connects the Caribbean Sea to the Pacific Ocean through a series of locks, artificial lakes, and channels, which together allow ships to be raised and lowered to compensate for the terrain during the crossing of the isthmus and the differences in sea level and tide levels of the two bodies of water. At the entrance to the Panama Canal, the Pacific Ocean can rise as much as 15 meters, but 50 kilometers away, the difference between high tide and low in the Caribbean is just around 2 meters. The longest part of the canal is the manmade Gatun Lake, which cuts through a low point in the Rockies-Andes mountain chain that runs all the way from Alaska to the tip of Argentina. Locks at each end lift ships up to the lake at 26 meters above sea level.

Capacity

The current two lanes of locks are 33,5 meters wide and can handle the Panamax ships previously discussed. At full capacity, the canal can facilitate 35 ships a day, far short of demand. Dozens of ships typically are moored off each coast, waiting a day or longer to enter the canal.

Modernization

A \$5,25 billion project to expand the canal by adding a third set of locks, scheduled for completion in early 2014, but beset by labor strikes and other problems, is now set for the end of 2015. While the locks will be able to handle "New Panamax" ships — 25 percent longer, 50 percent wider, with a deeper draft and able to carry two or three times the cargo of existing Panamax ships, no more than 15-20 additional passages will be added per day. Thus, the net effect will be to modestly increase transport of some types of freight regionally to the Caribbean seaports of the Americas, but it will not provide a strategic transit lane for Far East-European trade

nor for Pacific-North American trade, which is sophisticated, highly intermodal, and stretches by rail north-south, east-west on multiple rail routes.

Other Possible Implications

A longer view, however, surfaces potential for significant disruption. The Caribbean is awash in oil, present in vast quantities in the US, Venezuela, and Mexico — alone enough, given the right political and economic conditions, to negate flows to the hemisphere from the Middle East and in addition to the reserves of natural gas, oil, oil sands, and shale in the US mainland, Canada and the Arctic shelf above them.

If Chinese influence in Latin America continues to grow, it will do so amidst some of the worst poverty in the world and an historical backdrop of Latin American animosity to the past US policies in the area, which have been interventionist rather than constructive. Latin America is the source of large exports in fruit and agriculture, but its population ranks among the poorest and most desperate on the planet today. It is home to both small and large, organized crime gangs, which have thrived under decades of poor and corrupt governments and now have assumed local power outside the few bastions of government presence. Columbia to the south, like Afghanistan, is an the epitome of organized crime in the mantle of sovereignty, and Mexico has been in civil war for two decades attempting to avoid that descent.

Inside the Caribbean basin, there is Cuba, the largest island in the archipelago, where the last bastion of communism, Fidel Castro's regime, is drawing to an uncertain end, leaving an educated, but impoverished population and no modern infrastructure of any kind.

To the southeast, the island of Hispaniola, divided between the nations of Haiti and the Dominican Republic, is home to crushing poverty on a scale comparable to that of Bangladesh and parts of Africa. After a catastrophic earthquake killed as many as 100,000 and left 800,000 destitute in the Haitian capital of Port au Prince, cholera raged for three more years, ravaging an already desperate population with calamities of biblical proportion.

Nor will that be the last destructive act of nature — all of the Caribbean (except the South American coasts) is subject to the recurring August-September hurricane season, which is caused by heat rising from the Sahara desert and gathering momentum from the earth's rotation across the trade winds. All global warming models predict increased desertification and drought in northern and equatorial Africa, which can only increase the strength and destructiveness of hurricanes in the Caribbean.

Finally, *Panama sits astride the final rail link needed to connect the two continents. Into this cauldron, given the right alchemy and several decades at least, Panama has the potential become an American Singapore.* To do so, however, both Chinese influence and the

myriad unknown events of the future, would have to take marked deviations from past decades. The tragedies of Latin America, as with the stubborn, sluggish economies in South America, have been centuries in the making. Cheap labor, and the poverty that is its wellspring, is an abundant commodity on earth, and neither globalization nor climate change portends improvement for the poor.

SUEZ CANAL

The Suez Canal is the most recent of thousands of years of engineering efforts to open the Mediterranean to the Red Sea. Various ancient canals from the inland Nile are known, with attempts at both east-west and north-south routes. The Greek historian Herodotus recorded a 100 kilometers east-west route beginning near modern Ismailia, following a caravan route along Wadi Tumilat between the Nile and Sinai, cost the lives of 120,000 slaves during its construction between 600-500 BCE. The Tumilat canal seems to have become repeatedly obstructed and reconnected, but it is thought that, at times, it gave the ancient Egyptians a direct naval link to East Africa, Arabia and possibly even India.

The present canal was also constructed with forced labor — more than a million workers labored over 10 years from 1859 to the opening of the canal in 1869 — under the watchful eyes of the engineers of the French Suez Canal Company, which had gained the concession from the Khedive, Sa'id Pasha. The canal had an immediate and dramatic effect on world trade. Combined with the American transcontinental railroad completed six months earlier, it allowed the world to be circled in record time, as Jules Verne famously illustrated in his novel, *Around the World in 80 Days*. It also revolutionized shipping, since sailing vessels could not transit the canal due to the prevailing winds of the area. By 1873, it was the cause of an economic panic, as ships that once carried the goods from the Far East around the Cape of Good Hope and the entrepôt ports, used to transship cargos all became suddenly obsolete.

Six years after the opening, debts forced Sa'id Pasha's successor to sell his country's share in the canal to Britain, and by 1914, British occupation of Egypt became formalized as it declared the country a British Protectorate. From the beginning, it played an important historic role both commercially and strategically as the key passage in the British Empire to India. From Mumbai to London the canal roughly halves the 20,000 kilometers route around the African capes. In a world in which the Greenwich Meridian divided the globe in two, and British mercantilism dominated world trade, the canal was the first geographic landmark memorized by generations of school children. Until the dissolution of its empire, it was the centerpiece of all British strategy. Without it, neither oil nor trade

flowed to its islands. It was not by accident that Britain's opening offensive in World War II began in Egypt; the North African campaigns reflected the reality that loss of Suez would mean loss of the war.

In 1951, however, Egypt repudiated the long treaty that had granted Britain control. In July 1956, a month after the last British troops were removed, Gamal Abdel Nasser nationalized the canal, taking over ownership from the Suez Canal Company twelve years before the original concession was to expire. Nasser's move, prompted in part by the need for funds to build the Aswan High Dam, caused an international crisis. In October, Israel invaded Egypt, and British and French troops, in an attempt to retake the canal, occupied Port Said, Ismailia, and Suez. The canal was closed with Egyptian ships scuttled in the channel. An UN-brokered cease-fire followed quickly, and Egypt reopened the canal in April after an international team cleared the channel.

The canal was again closed by Egypt when Israel occupied the Sinai during the Six-Day War in 1967. It remained closed with wrecked and trapped ships until June 1975, when the waterway once again was reopened to international traffic. In the interim, however, the October 1973 Yom Kippur War, and US aid to Israel, had fostered the OPEC oil embargo. The impacts rippled forever through the world economy. By the end of March 1974 world oil prices had increased four-fold and led the world into recession. Of much longer-term impact, the recession, coming shortly after the American defeat in Vietnam, forced the US off of the gold standard, ending the long Bretton Woods monetary system. By the time the canal reopened, after 20 years of canal shutdowns, oil shippers — rooted in a futures-oriented industry — already had applied new lessons of economies of scale to emergent fleets of supertankers, which combined with pipeline construction, high oil prices, and changing import patterns made deep sea oil transit attractive in cost and stability.

With British merchant trade long gone and large-scale oil tanking migrated around the Cape of Good Hope, the Suez Canal's value to merchant shipping is significantly reduced from the key position it once played, a reminder that both cargoes and trade partners in modern times are fickle, fleeting, and fragile. Today, the future of the canal is uncertain, with plausible scenarios that portend both an increased and a diminished importance.

Political Issues

Much uncertainty arises, as it has from Egypt itself. From neolithic times, it has been conquered and occupied by more nations than any other in the world. As a modern state, it has existed only since 1952 and has taken various forms, including the United Arab Republic, a short confederation with present Syria. It was ruled autocratically by three presidents over the six decades, by Nasser from 1954 until

his death in 1970, by Anwar Sadat from 1971 until his assassination 1981, and by Hosni Mubarak from 1981 until his resignation in the face of the 2011 Egyptian revolution. From 1967 until 2012, except for short break in 1980, Egyptians lived under emergency law.

In June 2012, Mohamed Morsi won the presidential election to become the first democratically elected president of Egypt, but before he was sworn in, the Supreme Constitutional Court ruled that the election law was unconstitutional and ordered the elected bodies dissolved. Undeterred, Morsi assumed office and invited the elected bodies to meet to discuss the ruling of the court. By this time, Egyptian politics included more than 35 political parties. The elected parliament determined that the constitutional court did not have authority to dissolve it and undertook the draft of a new constitution. Proposed constitutional amendments were approved in December 2012 by a national referendum. with new elections scheduled for April 2013, which were postponed to October 2013 to comply with a technical order of an administrative court.

Amid new protests across the country, the armed forces removed Morsi and assumed control of the country. In June 2014, Abdel Fattah el-Sisi, the former chief of the Egyptian armed forces, who lead the removal of Morsi, was declared winner in a new presidential election. Faced with severe economic problems, Sisi immediately imposed a series of austerity measures, including an 80-percent increase in fuel prices and sharp cutbacks in food subsidies.

Canal Limitations

Unlike the deeper, shorter Panama Canal, there are no locks because the sea level is the same at both ends, and the Suez canal is wider. But the canal has sharp limits in size imposed both by its depth, which after dredging in 2009 still limits ship drafts to 20 meters, and by mast height, which is limited by the Suez Canal Bridge. This means that large bulk carriers and supertankers choose the longer routes.

Also, the present canal is largely limited to one-way traffic — either ships heading north or south — as it is too narrow at some points for vessels to cross both ways. Transits are limited at present to less than 50, and waiting time through the canal can be longer than 10 hours at time. On a typical day, three convoys transit the canal, two southbound and one northbound. The passage takes between 12 and 16 hours at a speed of 8 knots, in order to prevent erosion of the banks by ships' wakes.

In August 2014, at a lavish groundbreaking ceremony that included a military air show and the symbolic detonation of demolition explosives, Sisi announced a large expansion of the canal, which has been greeted with mixed enthusiasm and skepticism by the shipping industry. There has been talk for years of expanding the

development along the canal, which is one of the Egyptian government's principal sources of hard currency. The plan includes a "Suez Canal corridor," with new ports and industrial and economic zones around the waterway. Sisi's government announced the military would lead the effort to dig it, at a cost of \$4 billion, and would supervise Egyptian companies selected to participate in the project.

The plan appears to be proceeding. Soon after the announcement, Reuters reported Egypt had chased the Saudi engineering firm Dar al-Handasah as the lead contractor. In September 2014, Egypt's central bank announced on state television that it had raised the funds to undertake the project by issuing 5-year investment bonds bearing 12 percent interest and estimated the expanded canal and industrial complex would increase Egypt's annual canal revenues from \$5 billion to \$13,5 billion.

Connections to Europe

There are, too, issues surrounding the route itself. The Panama Canal facilitates transits between oceans. The Suez Canal does not. Instead, it has serious drawbacks on both ends. In the south, piracy in Somalia has been a significant issue, increasing insurance rates even as Egypt has also raised its rates through the canal itself. A combined international naval force has succeeded in reducing the number of attacks, but the increase in insurance may or may not decrease. In the north at Port Said, the canal leads into the Eastern Mediterranean Sea, where further transit through the Gibraltar Straits is necessary to reach the great EU ports on the North Sea. Otherwise, the terminus is in the Mediterranean itself, where good ports abound on the northern rim, but hinterland connections by rail to the rest of the EU are rudimentary.

One indication of this is reflected both in port throughput figures. In terms of container traffic, in 2011, the Atlantic and North Sea ports handled among them 50,000,000 TEU, while the Spanish ports of Algeciras, Barcelona, Las Palmas and Valencia handled only about 20 percent of that 11,000,000 TEU. Though the Spanish ports are modern and have capacity to spare, connections to the rest of the EU are a major point of blockage because of different rail gauges.

Moreover, the two routes out of the Pyrenees leads across French-government-owned SNCF rail, which is overwhelmingly a passenger carrier and very limited in freight capacity. From Valencia to Barcelona, there are significant bottlenecks, as there are from Barcelona to the Rhone Valley. For the French government to upgrade freight rail to accommodate Mediterranean access not only would pit the interests of Le Havre against Marseilles, it also would add the Spanish ports to the competition, while at the same time having the overall effect of increasing transport to the German economic engine along the Rhine.

Of the remaining largest Mediterranean ports, Malta, Gioia Tauro, Genoa, La Spezia, all largely serving Italian commerce, handled only 7,700,000 TEU. Freight rail connection through the Alps is also problematic for all the same reasons, plus the Italian economy has been in the doldrums since its brief expansion in the 1990s. Further east, for the EU, Mediterranean logistics poses its greatest challenges. The Eastern Mediterranean has almost no modern rail or port infrastructure outside of Piraeus, where Chinese port operators have recently begun to build container wharfage. Moreover, a significant portion of its future value lies in connecting to Black Sea, where the EU has refused entry to Turkey and Ukraine.

Much of the future commercial value of the canal, will depend on the future of container shipping lines in Europe. How those alliances play out, and how the future economics of shipping routes evolve in the wake of a potential slowdown of the Chinese economy or in a scenario of Far Eastern regionalization, remains to be seen. The strategic value of the canal to the EU, however, is of primacy.

STRATEGIC CONSIDERATIONS

Unlike the Panama Canal, the Suez Canal can accommodate aircraft carriers of all sizes, including the US Nimitz and new Ford classes of supercarriers, which the largest warships ever built and the air and sea lynchpin on which US, EU, and NATO military operations depend. Without the canal transit, US carrier-based strike groups on station in the Persian Gulf or in the Mediterranean Sea could not be rapidly redeployed in crisis, a maneuver critical to many past crises in the Middle East and central to the deployment of force in both Gulf Wars and in present campaign in Afghanistan.

Case: Carrier Strike Groups

At present, the US Navy maintains eleven carrier strike groups (CSG), which rotate in service — typically one carrier forward deployed for up to a year, while its relief “works up” or exercises near US home waters, and a third undergoes shipyard maintenance. Thus, three such groups are required to support one forward-deployed, though in crisis, this is abandoned, creating a “surge” capability. Such groups are “home ported” on the US East and West Coasts, but the Panama Canal cannot accommodate the carrier size. Thus crisis in the Middle East is usually met with a “surge” of an East Coast-based CSG in the Mediterranean Sea joining a West Coast-based

CSG in the Persian Gulf (or vice versa.) A CSG normally consist of one aircraft carrier and its onboard airwing of seven squadrons, one guided missile cruiser providing air defense, and three or more smaller ships, as well as a submarine often in attendance.

Losing the canal would force both an immediate crisis and a very high potential for a fundamental shift in global power. It would have an immediate impact on the US' ability to support both the EU and NATO defense – including unraveling of the new ballistic missile defense deployments, which in the current military posture of the EU, would leave it defenseless. From that, and also would have a ripple effect throughout the EU and NATO countries, where the US and allied bases from North Cape to Diego Garcia are key. In Europe, those countries include Norway, United Kingdom, Germany, Poland, Romania, Greece, Italy, and Spain.

Moreover, without two carriers to provide mutual support, there would be insufficient air cover for defense of the battle force. The US Navy surface forces immediately would be forced back considerably south of the Strait of Hormuz, where it would be unable to defend Saudi Arabia and the other Persian Gulf allies. To regain entry, large ground forces of the size of the two invasions of Iraq would be required. Faced with this, a US president would have to seek Congressional approval for operations of the size required, as they have in the past. This time, though, three factors would change the calculus:

1. There are the issues surrounding the US willingness to conduct the operations. The US no longer imports oil from the Middle East. Instead, the bulk of Asia-bound tankers are headed to China. Instead, there is great political pressure for exporting oil, and oil interests, once pro-intervention, would make it difficult to achieve political consensus. Canada, which now builds its economy around petroleum exports, is likely to have the same political concerns. There is too the change in procedural rules within the US Congress passed a decade ago that has made consensus increasingly difficult on any issues. No president, however, could lawfully proceed without that approval for a large-scale operation. Finally, all the US voter polls in recent years show a clearly discernible and growing isolationist trend. All of these are new.
2. The US military leaders are not likely to want to intervene either, as they have not in any of either of the two Iraq or the Afghanistan campaigns. Those campaigns have cost \$1,28 trillion since the World Trade Center bombings and have left the US ground forces shattered, while its aircraft and weapons inventory, as well as cadre of pilots, are seriously depleted. The cost of a single cruise missile firing exceeds 700,000 €. Since the

present air campaign against IS terrorists, the US aircraft have already fired 50 missiles in addition to all other ordnance. Planners do not believe that the nation will support additional budget increases to recoup losses from Suez campaign. Instead they are sharply focused on the Pacific, where Japan has forced the US from Okinawa, creating a necessity for an enormous expenditure of funds to build up the remaining the US territory at Guam. This will create a strong undercurrent with considerable political backing to pull back from Europe in general.

3. For the first time, China's naval forces have reached a stage of sophistication, operational capability, and numbers that a deployment to the Middle East in such a scenario would not be unexpected. This vastly ups the risk of Middle East operations in general, and of a China-Iran alliance specifically, upsetting the military political calculus of the region for decades while securing for China all the oil it needs.

Moreover, in the longer run, prolonged closure and commitment to further support the EU, would likely require new construction of at least three carrier battlegroups and an additional three amphibious assault groups, with the attendant aircraft, personnel, and supply infrastructure — an immense increase in defense spending amounting to a visible and internationally controversial naval and military buildup.

The implications for the EU would be profound. The expectation of the US participation in its defense is central to keeping the EU military forces and costs well below that needed to defend its territory. In terms of general military strategy, no technologies have emerged to replace the role sea power plays in its ability to open up enemy flanks to attack, which defense of the EU demands as a function of its geography.

By NATO agreement, the US is expected to provide as many as five carrier battlegroups and a similar number of amphibious assault groups. Since war with NATO would involve nearly all of the countries in the EU, de facto it would also mean a war with the EU. The EU's carriers are few, small, and lack the operational capability to provide for either naval defense at sea or offensive and defensive air operations beyond the reach of land air bases and early warning radars. In particular, it would open up the Norwegian and Barents Seas in the north and the entire Mediterranean underbelly of the EU, from which defense in the east also arises, to attack. Of the EU's present aircraft carriers, the largest, France's Charles De Gaulle is less than half the size of a US carrier; Italy's new Cavour, a quarter the size; and Spain's Príncipe de Asturias, is no longer able to get underway. Britain's remaining carrier, HMS Illustrious, is antiquated. Two new carriers are on the ways to be delivered, but they two-thirds the size of the

US class and lack the launch capability for high performance aircraft.

Britain, then, would be faced with similar dilemmas as the US, and France as well. In such a situation, nuclear deterrent, which is the operational power in both navies, would be useless. Both of those countries would be faced at some point with long-term decisions about the viability of remaining in the EU to defend what voters there could easily see as a German economy that has refused to fund for the common defense.

This is not as far-fetched as it may seem at first. Britain and Norway have long traditions as Atlantic nations, are lynchpins of NATO, and both are unlikely to recast their defense posture to the exclusion of NATO. And yet, the crisis in Suez would force a fundamental reckoning within NATO.

Moreover, the relationship among the so-called “cousins” (US, Canada, UK, Australia, New Zealand) is the deepest and most enduring political bond on earth. The US build up in the Pacific should be seen in that light; two new bases are being built in Australia in direct result of China’s buildup.

Finally, there is this to consider in the newly globalized world of the EU. Where once self-sufficiency may have been possible on the continent, export economies are now the new norm, and with them come the necessity both for merchant shipping and support of that shipping. The days of viewing Continental Europe as a land power are gone.

And yet, there remains the burden of land defense in addition, especially given the vulnerability of Eastern Europe, whose voters understand they have been snubbed by the EU. All of these implications are both possible and plausible, presenting no good choices, whether planning for them or ignoring them. Such are the dilemmas produced from a hostile blocking of the canal, which is shrinking in its commercial value to the northern EU nations, while its merchant shipping companies all have moved into alliances and arrangements China.

If the EU succeeds in remaining a maritime trading block without ships and the political leverage of strength, it will be the first in history to do so.

THE 125TH PARALLEL

By far, the world’s busiest and most competitive routes are China to Europe and China to the US. Interestingly, the industry and the media have a sort of geographic myopia about these routes: they are nearly always expressed as Europe to China and the US to China. Even maps are drawn that way. By any measure, however, after 2000, the centerline of world trade is along the longitude of 125 E.

Fourteen of the world’s largest container ports are located in the basins of the East and South China Sea. All of the world’s container ships and containers

are made there. All of the world's major shipyards are there. Ninety percent of the world's steel is made there, and nearly all of the globally transported iron ore and aluminum/bauxite is destined for those waters. China is home to the world's three biggest public companies, and five are in the top ten. Four of the five are banks, and all were reporting record bad loans in late 2014. The Industrial and Commercial Bank of China (ICBC) holds the number 1 spot, followed by the China Construction Bank, the Agricultural Bank of China, and at number 9, the Bank of China. All of them are state-owned.

Given these facts, it is worth recalling the reaction of Europe's big three container lines to China's refusal to approve a proposed shipping alliance among them. Approval would have given the group a 47 percent share of the Far East-Europe route. Yet, China's decision is wholly consistent with all of its actions since Deng Xiaoping unlocked the Maoist handcuff. Barely a century after the last dying gasp of Imperial China, once prostrate before the European, Japanese and American powers occupying its ports, Chinese merchant shipping is now the largest in the world. All around it, the East and South China Seas and Indian Ocean are poised to hold the largest markets in the world, and many of the world megacities in 2025.

In this view, growing trends toward regionalism come into sharper focus.

THE IMPLICATIONS FOR REGIONALISM

In the long run, it matters little whether one fortune or another is lost in the freight derivatives market, but it matters a very great deal if the industrial base of shipping is lost to a nation or a trading block. It may be that the marketplace will sort out the shoe business, but market forces are only a small part of the stakes in maritime shipping, and it has always been so. *Shipping has implications that transcend the industry itself. It is one of a handful of commercial enterprises, that are so vital to the nations, that they depend on them, and they cannot be allowed to fail. A nation might let its shoe business go belly up, but if it depends on world trade for its economic life, then ships and shipping infrastructure take on a value as a national industrial base.*

Yet, this is precisely what is happening in the EU. There is a reality to contend that in the six years following the 2008 financial crash Europe's strategic position in maritime trade has slipped while its need to export has become all but absolute. This, too, is new and on several levels. For five hundred years, the UK was the key import-export economy in the world, and the only maritime power in Europe. The Royal Navy, still the only operationally significant naval power from Portsmouth east to Shanghai and growing, is but a shadow of what once was.

Continental Europe, before wars, Bretton Woods and globalization mandated exports, was sustainable as a land power. No longer, and in ten short years, it has

lost much of shipping dominance. The three largest container shipping companies in Europe, once the largest in the world, have slipped from their perch, with the top two merged into a shipping alliance, and the third, a stepchild of a temporary alliance with China and a Middle East consortium.

Frontline Ltd, the largest tanker company in the world, controlled by Norwegian John Fredriksen (but incorporated in Bermuda) has been forced to merge as well. Europe's great shipyards, are all but gone, with only the Italian yard of Fincantieri, which specializes in cruise ships, left. Even Britain is outsourcing Royal Navy construction to Australia, where tangentially and out of the eyes of voters, cheap labor can be imported.

Time is pressing: the EU expenditure in intermodal shipping, especially in connective freight rail, and in port improvements has stalled, losing precious momentum in an age when technology investment is critical to staying competitive.

Europe's maritime dependence though new in its history is now absolute. The pre-war shipping lines that were directly coupled to national interests all were lost, and in their place grew commercial shippers. Of the big three companies in Europe, only Maersk is a public corporation. MSC is a private corporation cloaked completely in Swiss law. CMA-CGM, an unsteady amalgam of previously nationalized French lines with a long history of political influence and arms dealings, is as well.

The net effect of all of this is that the EU, dependent on maritime trade, is the only such power in all of history that has gone to sea without a navy and without strong national backing in one guise or another.

The root problem surfaced during the 2010 debt crisis, and again in October 2014, when the EU banks lost immediate value after the European Central Bank released the results of bank stress tests. Subsequently significant errors were found, but shares did not regain.

As an economic bloc, the EU has not yet formed political and defense structures parallel to its economic institutions. The net effect is that, where once in Europe powerful ministers held national maritime portfolios, they went the way of merchant marines. They were not replaced. More simply, the EU, which cannot survive without shipping, has left itself to the mercy of the big three shipping companies. The hope is that Maersk, CMA-CGM, and MSC have that for action.

They do not. No further proof is needed than Maersk's decision to close the Odense shipyard and give its business to China. Or CMA-CGM's decision to throw its lot into an alliance with a state-owned Chinese and Arab shipping companies.

These risks are unique to the EU and not shared by the other two regional trading blocks. The reason for this, also is new, and an irony of history. Of the three mega-economic regions that emerged from the last 25 years of globalization, only Europe now depends utterly on maritime trade.

The Americas, if they choose in some future scenario, can be economically self-contained, though not, of course, without an initial struggle in the disentanglement from the present economic flows. In 15 years, the largest sector of the US population will be under 40 years old and of Latin descent.

After 100 years of foreign entanglement, the last 25 years of brutal combat in the Middle East, every poll of the US voters consistently reflects a sharply rising neo-isolationist sentiment.

Running with this undercurrent, North and South America have every commodity needed to conduct a viable economy. They possess large populations of middle-class consumers and even larger sources of cheap labor. In 2012, for the first time since 1954, the US became a net exporter of crude oil. As we shall see in subsequent sections, Canada and Greenland, not Russia, are best poised to benefit from the Arctic melting.

In Asia, China's dominance geographically, politically and militarily is unquestionable, and certainly as an economic power, it can no longer be considered a "developing" nation. It is easy to overestimate China: every day its leaders wake up to 1,4 billion people who all now have expectations. China has many problems, but without question, at the moment, it holds the rest of the world temporarily hostage.

If the world continues along the same general track of truly global trade, China will play a key role. In a different scenario, one in which the world regionalizes, the Far East will be home to most of the world's largest cities, with ample labor and an emergent middle-class. Lacking in some commodities historically, especially energy, the region at large and China specifically has new options, which should be closely watched.

But in the same calculus, it is difficult to see how the EU can stand as a region. Even internally, rail and road within the EU is limited. The Achilles Heel of the great North Sea ports is that modern hinterland freight transport on an East-West axis ends abruptly at the Rhine, and there is no high-speed freight at all on a North-South axis.

Without a viable maritime shipping and access to both local and distant ports, the EU trade cannot recover. The past 25 years of globalization have not taken place without fundamental directional change.

It requires no more supposition to build a scenario for regionalization or even a closure of the world for a continuation of the status quo. "Globalization" as we have experienced it has always been an overstated condition.

A prolonged shipping downturn such as being experience today has a great many different effects around the world. In some regions, high costs forces the shelving of port expansion plans and ship orders, and lead to the merger of companies. Elsewhere, the opposite can happen, as is happening in China, where government funding plays a

large role in investment, and where the slowing down of its economy has increased the government's willingness to invest in infrastructure. In such a situation, the longer the slowdown, the wider the gap, especially in port and hinterland connections.

NEW VISIONS

Against this backdrop, there is the relentless global warming that portends to regular circumpolar navigation above the Arctic Circle, certainly within the next 25 years. Arctic circumnavigation will require new ships and new ports, as well as new road and rail connections, at least in the Eastern Hemisphere.

We think the impact of both the Northern and the Northwest Passages are presently greatly underestimated. We believe both hemispheres, for different reasons, will be modernized and made feasible for commerce as soon as possible. The Northern Passage is absolutely needed to make the transit from East to West in Russia above the Transsiberian line. It is the key to opening up Siberian wealth and its best option for rapidly building a transport infrastructure inside its borders.

For Russia, the stakes are enormous. For Finland, great risk and great opportunity both can be presented. To the Canadians, the Northwest Passage from Labrador to the Beaufort Sea is national territory. It will build the bases to defend that, and therein lies its motivation. For the Americans, there are different motivations. Alaska, the Aleutians, and now, on the northern slope of Alaska have been and always will be the key to defense of the Pacific.

But the real value of circumnavigation over the next 30 years likely will not be its role in opening up a new way to circle the Earth — that will come later if economic considerations warrant it. The melting of the Arctic will bring, for the first time since 1492, vast tracts of largely unexplored land will open up: in Greenland, in Siberia, under the ice in the Arctic and on the continent of Antarctica.

Regardless, if riches are exploited in sufficient amounts, it would be instructive to reread the worldwide economic turmoil following Spanish exploitation of gold and silver in the New World.

Without doubt, the largest amount of riches lies from the Urals to the Pacific. Among the many geological features that cover that vast expanse, first among them is the great Siberian Craton, is as much as 350 million years old and has an entirely different paleogeologic origins than the rest of the Arctic.

But for Russia, it may already be too late. The world is awash in fossil fuel, and there are no signs that burning it is going to stop. In real terms, Russia is two centuries behind the rest of the world in terms of infrastructure. That is Russia's Dilemma. All the riches in Siberian cannot magically appear.

Chapter 4

Dawn in the North

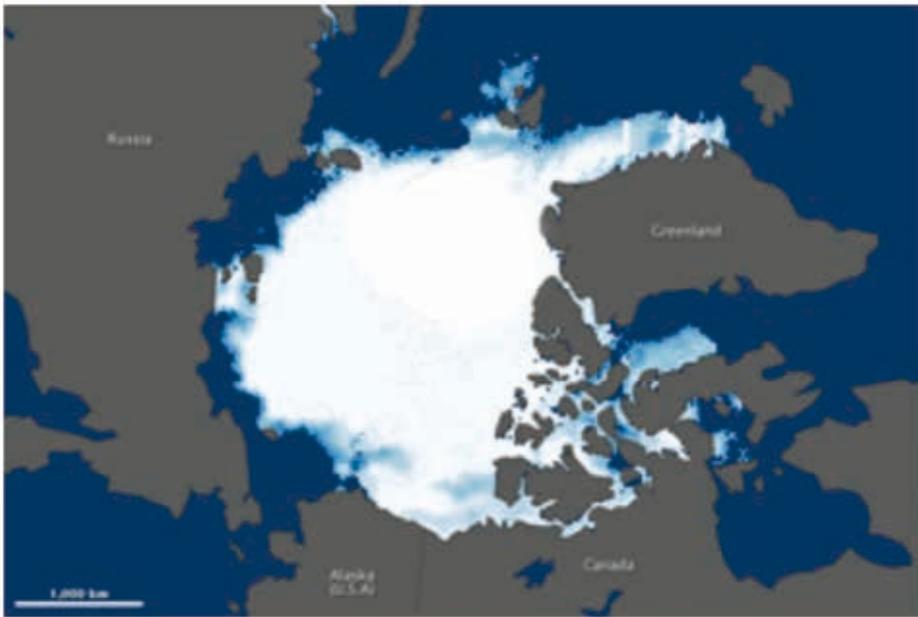


Figure 7. NASA: Picture of Arctic, September 14, 1984.

GAME CHANGER

THE ISSUE OF MELTING

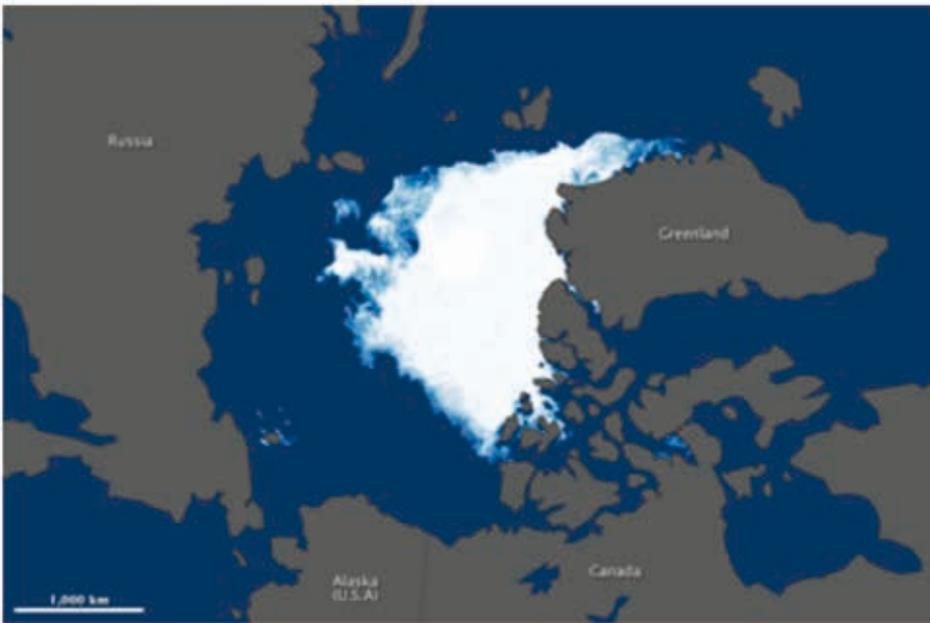


Figure 8. NASA: Picture of Arctic, September 13, 2012.

The issue of whether the Arctic will melt is moot: it is melting. Whether it will continue to melt, if the direct causes are deforestation and the burning of fossil fuels, as is the prevailing view at this early relatively ignorant stage of scientific climactic knowledge, then that too is likely to be moot. Both of these have been ongoing for centuries, and both are economic in origin. To believe they will slow, much less stop, is not only to go against what are now long term trends, but human nature itself and a burgeoning population nearly 2 billion more mothers and fathers all over the world that will want to feed their children and see them get ahead. Even before the collapse in energy prices in 2014 and the development of oil shale and oil sands technologies, world emissions were

estimated to increase by various figures ranging from 35 to 55 percent by mid-century. The world now appears to have greater fossil fuel reserves than ever, and at some production price, all of it will become increasingly available. A world that cannot be weaned from oil and gas when it was scarce and expensive will not be able to do so when it is plentiful and cheap.

There are a group of persistently stubborn problems in this, of which three are especially germane and illustrative.

In the US, transportation emissions are enormous contributors of the world crisis. Time and again, however, mass transportation efforts and higher taxation on gasoline prices have failed. Mass transportation projects have an extraordinary price tag, typically reaching \$10 million per mile and often as much as \$60 million, and decades are required for completion. Many false starts have occurred, especially in the 1970s and 1980s when the oil crisis reached a peak with the OPEC embargo. Anyone who has ever flown into Dulles Airport at Washington DC is familiar with the bizarre custom “moon rover” vehicles that were built, each spewing diesel fumes 24 hours a day, to ferry passengers across 100 meters of runway. The days of pushing such megaprojects through the American budget are long gone, along with the faith that they will work. The geography of American cities, and especially its distributed economy, has shown it to be impenetrable after nearly 30 years of attempts. For this reasons, Americans have also consistently paid for gasoline at nearly any price, and attempts to add taxes in times of high prices is political suicide, but attempts to do so during low prices brings an issue to the political campaigns that has not constituency either. Production of gasoline from refining oil-shale crude is a highly manipulated energy market, and the present low prices would have to quadruple to reach the thresholds where American workers appear to hesitate. When that happens, conservation doesn't set in, unemployment does. New engines and batteries are reducing emissions, but these developments are cranked into the predictive models for higher emissions already. What will change the situation is keeping Americans at home, which requires a restructuring to an increasingly virtual workplace. A second persistent problem is deforestation. Sustainability is an economic hype that spins a myth that replanting trees is as good as leaving them alone in the first place. A mature tree in site produces far more oxygen by volume per year than an immature tree. From there the mathematics are volumetric. Hand in hand with this is the myth of biofuel. Finland is a prime example of in this regard. Between its forestry and refining sectors, Finland's economy has come to depend on deforestation. No amount of risk seems to be able to budge its national addiction to cutting trees — whether palms in Borneo and Malaysia for biofuel additives or conifers for paper. This, too, comes down to jobs. Finnish pensions are in no small part invested in these industries, particularly in Neste Oil, which the government has for decades owned controlling share. Like

Americans and their cars, the individual family in Finland has its future invested in these pursuits, and absent compelling alternatives, no Finnish politician will be elected opposing them. Sovereign fund investment is problematic: clean industry rarely produces enduring returns, except perhaps in Switzerland. British taxpayers have a similar guttural connection with BP.

In China, steel mills and coking coal, which we examined in previous chapters, are also problematic. The consolidation of these antiquated mills would do much to lower emissions, but it seems to be beyond the reach of the Beijing government to control provincial power in this matter.

Nevertheless, there are several considerable forces for change. Unless you are human, the best of these is global pandemic that might roll our species back. Epidemiological models we have today show that deaths from pandemics are not enough to make a difference in the overall population, but they are so frighten and come on with such speed, that they can “close” the world very quickly. People stop traveling. Many organizations have examined scenarios for “de-globalization,” a sudden retraction of an open world into a contraction of enclaves. When that starts, a fragile economy, such as globalized one now, is very difficult to restart. Famine, on the other hand, which is likely and has been common throughout history sometimes many millions of lives, as happened in Russia and China in the past century repeatedly, is not enough death to make a difference in our collective rapaciousness.

Widespread changes in industrial processes (e.g. steel production, asphalt use) in a short time, coupled sharp curtailment in transportation emissions in the US, would have a significant impact. The trend toward megacities, is, in general, a positive environmental development. Herding us into cities refocuses the problem and the solution set markedly, if urban construction is funded and the society is ordered. That is the difference between Singapore and Lagos.

The most important change is not on the subtraction side of the carbon-oxygen equilibrium, but on the addition of oxygen in large volumes through worldwide planting and application of photosynthetic films to buildings and dwellings. Lowering emissions in this world has a long history of failure, requiring government interaction with industry and taxpayers in a calculus that just doesn't reduce. A sudden global grassroots environmental effort to plant native trees, which worldwide would take about 20 years to mature, might well stem the tide.

HOW FAR AND HOW FAST?

All of this begs the issue of whether the geomechanisms of global warming have proceeded past a point of recovery. If we mean by this a hope to return to a pre-

industrial climate, the answer is probably no. Certainly there is no hope, given ongoing responses to changed ecosystems, of returning an evolving biosphere backward. Because the entire planet is under assault, we must expect that there are wheels within wheels. From what little we know of complexity — that of butterfly wings creating hurricanes — we should expect very great change has, is and will continue from the underlayment of the past 200 years, no matter what we do. Biology works that way.

How far the melting will go is beyond our knowledge. Trends in the Arctic are clear, but the Antarctic is more puzzling. Both are now being monitored with increasing precision and frequency twice daily through a constantly growing set of satellite constellations. The various satellites, as well as the International Space Station, carry aloft a host of increasingly sensitive and diverse instrumentation. This has been one of the greatest international successes stories in scientific cooperation in world history. Some are launched into geo-synchronous orbit so that they are stationary over a point on the earth below. Others are put into polar orbits, the orbital mechanics of which route them across the poles twice daily. Polar-orbiting satellites are increasingly flown in groups or “trains” that fly in close proximity to each other in carefully planned formations, which allows for synergy in instrumentation so that more information about the condition of the Earth is obtained from the combined observations than would be possible from the sum of the observations taken independently.

The instrumentation is very diverse, measuring temperature, humidity, aerosols, and more and includes sounders and radars in different spectral bands. In 2012, a satellite called the “Shizuku” built by the Japanese JAXA space agency was launched into orbit to join a constellation known as the “A-train.” It carried the first extraordinarily sensitive microwave scanning radiometer, which bounce beams of much higher energy wavelengths off the Arctic surface than in the past, allowing penetration of the polar cloud cover that often hides the surface from less sophisticated instruments. This now provides a highly detailed image of the Arctic sea ice (and other visualizations) twice daily and made available worldwide. Once over the pole, it scans every 1.5 seconds, with each scan covering an area 1,400 kilometers wide. In late 2014, a new satellite, called the Orbiting Carbon Observatory (OCO-2) joined and became operational. Its instruments pinpoint key locations on the surface where carbon dioxide is emitted and absorbed, taking more than 10,000 data points each day, which can then be modeled into a dynamic picture.

The data from all of the satellites is made available from the instruments’ mission control centers and disseminated around the world in a variety of forms.

NASA collects each instrument’s data and disseminates its around the world in “real time” in formats that can be used in hundreds of data models across the

agencies and universities of the world scientific community. In this way, for the first time, individual scientists and small groups — and the public — can access and manipulate highly accurate common data refreshed twice daily to conduct independent experiments and analyses. It is available on the web via a tool called “Giovanni.” Perhaps even more importantly, the advent of daily mapping defuses rhetoric about Arctic melting, which will help the political and economic debate considerably. We all can watch it melt, day by day.

THE MELTING TRENDS

The long-term trends have been clear since the 1980s: the Arctic Ocean is losing about 13 percent of its sea ice per decade. Record lows for minimal sea ice occurred in 2012. Snow cover extent above the Arctic Circle during spring 2014 was below average, and in April, Eurasia set a new record low since satellite observations began in 1967. Between 1979 and 2013, snow cover extent at the end of the cold season has dropped by 19,9 percent per decade relative to the 1981-2010 average, which is an even more rapid decline than the end-of-summer Arctic sea ice retreat. Snow cover is an important climactic factor because snow reflects 90 percent of the sunlight that reaches it, and snow-free ground absorbs much more.

The Greenland melting trends are also clear in the long-term, though short-term measurements are more complex. Since 1979, summer melt on the ice sheet increased by sharply, and in 2012, NASA estimates were that 97 percent of the ice surface experienced melting. Summer 2014 in Greenland was the warmest on record at Kangerlussuaq, West Greenland, where the average June temperature was 2,3°C above the 1981-2010 average. In January 2014, the average temperature at Illoqortoormiut, East Greenland and Upernavik, West Greenland were 7,5°C and 8,7°C above the 1981-2010 means, respectively. One of the best measures of both Greenland and Antarctica is provided by an orbiting pair of gravity measuring satellites called GRACE. GRACE measures changes due to surface and deep currents in the ocean; runoff and ground water storage on land masses; exchanges between ice sheets or glaciers and the ocean; and variations of mass within Earth. GRACE data gives also a long-term trend in total ice mass.

The trends are clear for the two trans-polar passages. Both have been open frequently times in the past 10 years, with the Eurasian Passage thawing more regularly and more extensively than the North American route. In 2014, the passage above Canada and Alaska remained ice-bound, while a finger of open water stretched north of Siberia in the Laptev Sea, reaching beyond 85° north, which is the farthest north open ocean has reached since the late 1970s.

AN OVERVIEW OF THE ARCTIC



Figure 9. Arctic Overview.

THE ARCTIC DEFINED

There exist many different definitions of ‘the Arctic’, based on physical-geographical characteristics or on political and administrative considerations within different countries. No simple delineation of the Arctic region is applicable for the purposes of all types of assessments.

The most common definition of the Arctic is by latitude: it is the land and sea area north of the Arctic Circle (a circle of latitude at about 66.340 north). For all locations, land and sea above that parallel, the sun is generally above the horizon for 24 continuous hours at least once per year (at the summer solstice) and below the horizon for 24 continuous hours at least once per year (at the winter solstice). The same definition includes the northernmost third of Alaska, as well as the Chukchi Sea, which divides the US from Russian at that latitude.

There are eight countries that have lands above the Arctic Circle: the US, Canada, Russia, Norway, Denmark (by virtue of Greenland), Finland, Sweden and Iceland. They are the members states of the Arctic Council, a cooperative forum established in 1996. Of those nations, only five are recognized as having coastal lands: the US, Canada, Russia, Norway, and Denmark.

This is a political definition, but other definitions of the Arctic are used as well. Biological definitions often use the extent of the northern tree line. Climatic definitions include the extent of permafrost on land or the extent of sea ice on the ocean. There is, too, a temperature delineation. An isothermal definition is also commonly used. It defines the land and sea area in which the average temperature for the warmest month, usually July, is below 10 degrees of Celsius. This definition is quite different that that of the Arctic Circle; in that the resulting area is irregular and would exclude Sweden and Finland, some of Alaska above the Arctic Circle, but includes nearly all of the Bering Sea and Alaska’s Aleutian Islands.

The Arctic Monitoring and Assessment Programme (AMAP), a working group of the Arctic Council defines its definition in the following way:

AMAP has defined a regional extent based on a compromise among various definitions. The ‘AMAP area’ essentially includes the terrestrial and marine areas north of the Arctic Circle (66°32’N), and north of 62°N in Asia and 60°N in North America, modified to include the marine areas north of the Aleutian chain, Hudson Bay, and parts of the North Atlantic Ocean including the Labrador Sea.

ARCTIC GEOLOGY

The geological origins of the Arctic landforms are both diverse and complex. Some of the oldest rock formations in the world lie near some of the newest. Parts of its bedrock that were once connected as part of ancient continents are now far

apart from adjacent pieces. Other formations that have never been adjacent are drifting together. Within the Arctic Circle are a number of large and ancient magma extrusions and volcanic traps. Along the continental shelves there are vast conventional oil and gas sedimentary basins that are estimated to contain as much as 25 percent of the known reserves from all of the rest of the world totaled. Non-conventional sources — oil shale and oil sands — are even larger.

Like all of the landforms on earth today, the present Arctic are an ongoing consequence of the long breakup of the ancient supercontinent of Pangaea, which began about 250 million years ago as part of a global cataclysm. Pangaea had been gradually assembled from the migration of older subcontinents during the previous 200 million years and progressively took the form of a long, but highly differentiated, land mass stretching from pole to pole. The world's single ocean, the Panthalassa, surrounded the entire mass. For reasons scientists worldwide continue to debate today, the beginning of the Pangaea breakup is commensurate with the largest of the planet's five great mass extinctions, in which 95 percent of all extant species were abruptly lost.

The prevalent theory is that neither the breakup of Pangaea nor the extinction cataclysm were created by bolide event such as that that decimated dinosaurs 200 million years afterward. Rather, it is thought that massive volcanic activity was the root cause for breaking Pangaea apart, and the attendant extinctions the result of rapid rise in global carbon dioxide levels from that volcanic activity. The area of the extraordinary volcanic activity is thought to be the vast geologic province known as the Siberian Traps, which stretches from eastern slopes of the Ural Mountains for a thousand kilometer and is covered by 2,5 million square kilometers of basalt. The Siberian Traps are the source of the mineral wealth (but not the energy fields) found in Siberia today. It is believed an enormous mantle plume rose to the surface, creating especially violent and prolonged volcanic activity. The plume seems to have emerged in an area centered on present-day Norilsk, creating as it great deposits of minerals as the lava cooled. The Norilsk-Talnakh nickel-cobalt-copper-palladium deposits are such an example.

The mass extinction marks the boundary between the Paleozoic Era, during which life arose, and the Mesozoic Era, the age of dinosaurs. During the latter part of the Paleozoic, vast sediments from marine plankton and from the first great terrestrial forests were laid down, which were compressed and deformed extensively during the formation of Pangaea. Two of the richest reservoirs of oil and gas on earth, in Texas and in southern Russia, were trapped in the sedimentary rock from the Permian period, the last before the breakup.

Pangaea began a long process of rifting involving two distinct processes. The first was the division of Pangaea along and east-west axis near the equator creating two new supercontinents, Laurasia and Gondwana. This process continued throughout

the Mesozoic and was attendant with the gradual formation an equatorial sea, the Tethys, which changed greatly in size and shape in response both to tectonic plate movement and to climate change. All of this occurred amid fluctuating climate change in which the new geography created a dramatically different set of global ecologies, with a far warmer climate, and much more shore line.

During the middle age of the dinosaur periods, the Jurassic Period, a second geomechanism came into play with a north-south rifting of Earth's mantle, nearly pole to pole, along the approximate longitude of 200 east. The result was the creation of vast chain of underwater volcanoes known today as the Mid-Atlantic Ridge. It remains the principal geomechanical force on the planet today, pushing the Western Hemisphere apart from the Eastern Hemisphere through the creation of new ocean bottom from the lava flows. It is the world's longest and highest mountain range. In the North Atlantic, the volcanic ridges are higher than the Himalayas. Along the way, volcanic islands created by the ridge include Tristan da Cunha, Ascension Island, the Azores, Iceland and Jan Mayen Island. The rift begins at the sub-Antarctic Bouvet Island, which rises above a triple junction of the South American, African, and Antarctic tectonic plates. The ridge runs northward from there, without interruption, across the Arctic floor onto the Siberian mainland.

ARCTIC BATHYMETRY

The portion of the Mid-Atlantic Ridge that transects the Arctic floor is called Gakkel Ridge. It runs from the northeast coast of Greenland to the continental shelf off the Laptev Sea, where it is connected to the last part of the ridge system, which terminates in another triple junction in the remote Chersky Range in northeastern Siberia. The entire ridge is approximately 200 kilometers wide, 1,800 kilometers long and rises up to 1,000 meters below sea level. The width of the central rift valley varies between 20 and 40 kilometers and reveals a depths of 5,500 meters. The Gakkel Ridge marks the boundary between the North American and Eurasian continental plates.

Two great basins lie deep on the Arctic floor beyond the continental shelves. Gakkel Ridge divides the Eurasian Basin into two parts, the Nansen Basin and the Amundsen Basin. The geographic North Pole lies in the Amundsen Basin, nearer to Peary Land, Greenland than to the New Siberian Islands opposite.

The Eurasian Basin is bounded to the south by Greenland, Spitsbergen, and the Taymyr Peninsula and extends to a maximum depth in excess of 4,2 kilometers. Large amounts of water are exchanged between this basin and the Atlantic Ocean by way of the Greenland and Norwegian Seas. The water from the Arctic Ocean is cold and fresher while the North Atlantic Current provides warmer and more

saline water to mix in the basin. The continental shelf surrounding the Eurasian Basin is very narrow, averaging only 37 to 93 kilometers.

Further north, an unusual ridge of continental crust, the Lomonosov Ridge, is roughly parallel to the Gakkel Ridge and divides the Eurasian Basin from the much larger Amerasian Basin. The width of the Lomonosov Ridge varies from 60 to 200 kilometers. It rises to 3,7 kilometers — about that of the highest Austrian Alps — above the 4,2 kilometers deep seabed. Slopes of the ridge are steep and fingered by canyons. Russia, Canada, and Denmark have all made claims that the ridge is an extension of onshore mountains. In July and August 2007, a Russian expedition sent an icebreaker and two mini-submarines to explore the region and planted a rust-proof titanium metal Russian flag on the seabed.

The Amerasian Basin has a more complex bathymetry and is surrounded by a very broad continental shelf, up to 550 kilometers across, though it narrows sharply off the delta of the McKenzie River and westward to Point Barrow. The Amerasian Basin has an average depth of 3,7 kilometers and extends from Ellesmere Island to the East Siberian Sea. It includes the Canadian Basin (Beaufort Sea), which is connected with the Pacific Ocean by the narrow (64 kilometers) and shallow (45 meters) Bering Strait.

The marginal seas, which make up the edges of the Arctic Ocean over the continental shelf, occupy about a third of the entire ocean area but account for only two percent of the volume, an indicator of the great water depth in the two major basins.

CURRENTS

The Arctic Ocean is almost completely land-locked with only a few restricted openings, generally shallow, which act more as dams than as open passages for the circulation of water. Very little water circulation occurs on the Pacific side. The Bering Strait is only about 90 kilometers wide with less than 50 meters depth. There are also numerous but narrow and twisting channels throughout the Queen Elizabeth Islands in the Canadian Archipelago, and the Nares Strait, about 15 kilometers wide and 250 meters deep opens between Ellesmere Island and Greenland is the source of the southerly Baffin Island Current that carries Greenland and Labrador icebergs into the western North Atlantic. Ellesmere Island is a major source of “ice islands,” very large blocks of ice that calve from its northern shore and follow the clockwise gyre of the Amerasian Basin for up to several decades before melting and drifting southward on the Atlantic side. During the Cold War, both sides used such islands as covert bases. Several early polar expeditions took note of findings of flotsam from the Pacific that was found years later in Greenland.

By far, the greatest water flow in and out of the Arctic occurs via the Fram Strait between Greenland and Spitsbergen. Outbound, the East Greenland Current is a cold, low salinity current located directly off the Greenland coast that cuts through the Nordic Seas and out via the Denmark Strait. As it nears the southern tip of Greenland, a weaker current is spun westward up the Davis Straits where it is mixed with the Baffin Island and Labrador currents. In 2011, a second major southerly current was discovered flowing along the west coast of Iceland. Both pass through the Danish Straits, directly connecting the Arctic to the North Atlantic and to the global ocean conveyor.

They are the major contributor to sea ice export out of the Arctic, which is directly related to the massive outflow of the Arctic rivers, which carry hundreds of megatons of fresh water into the Arctic Basin. At the present rate, the Yenisei, Ob, Lena, Kolyma, and Mackenzie Rivers, draining a continental area of more than 10 million square kilometers, have a runoff equivalent almost half the Amazon. This fresh water, spreading at the surface of the heavier saline marine water, creates massive amounts of annual ice, which prevents normal convection and reduces vertical mixing.

It also seriously impedes biological development, a situation that is quite contrary to that of the Antarctic. The Southern Ocean is so biologically abundant with plankton and crustaceans it provides a significant portion of the Earth's food chain. These organisms have evolved along very different paths than those of northern latitudes, with much evidence pointing to a diversity created by the rifting of Pangaea so long ago. The biological richness of the Southern Ocean is also caused in part by its circular flow, which tends to prevent speciation of Antarctic forms above its northern limits. The Southern Ocean water flows freely around the Antarctic, since its general circular shape of Antarctica is interrupted only by the Antarctic Peninsula, and that is fully 1,600 kilometers from the tip of South America at Tierra del Fuego.

The Atlantic warming current originates off the tip of Florida and moves northward along the US coast as the Gulf Stream. It continues northward amid much mixing as the North Atlantic Drift. Off the Azores, it splits into several streams. One is the Norwegian Current, which moves warm water into the Barents Sea. There it warms water sufficiently to keep the Kola Peninsula ports navigable. The warming impact, however, ends abruptly at the Russian archipelago of Novaya Zemlya, which extends into much higher latitudes and the Kara Strait, which separates the Barents Sea from the Kara Seas, is very narrow, further restricting water flow. As a result, the Kara Sea is much colder all year and is frozen for over 9 months a year. At Novaya Zemlya, the remaining warm water spins north to the pole and across the Arctic to the Beaufort Sea in a series of gyres.

change or better nautical sailing directions. It is a complicated topic requiring depth and breadth of knowledge in maritime technology, geography and geology, industrial development, and considerable knowledge of global trade, especially in commodities.

Economic analysis of the passages remains minimal effort at present compared to the bunkum of advocacy. In Europe, nearly all of this comes from the Russian government and from news and trade papers that have a vested interest. Gazprom, the Barents Observer, and the shipbuilding press are particularly dubious. In North America, the Canadian regional press frequently takes on government reluctance to invest in the passage with stories of dubious potential. On the other hand, the Economist, Guardian, Wall Street Journal, and the New York Times are among many producing quality analysis. This is largely a function of the adolescence of the Arctic melting. The real possibility of polar passage is a new topic, less than 10 years old as a public dialogue, and as experience and knowledge increases, advocacy will be seen for what it is. Russia's intrigues in the Ukraine, in particular, have served to sober the naive. We address some of the specific claims as they arise in our discussions of each passage.

There are at least three distinct and fundamentally new developments of global import inherent in the Arctic melting.

Trans-polar surface passage between the Atlantic and Pacific Oceans via a near-continent coastal route commands most of the attention, but it is not likely to be the dominant or most economically important in any scenario. Even the hauling of commodities, which is the principal traffic for the foreseeable future, begins mid-passage on both continents. Bulk carriers are problematic in the shallow waters of the Russian passage. Oil tanking has to compete with pipelines and other routes around the world, and on the Canadian side, there is ample infrastructure in place send such cargos south and west from Alberta, not north to a new port. LNG has its own problems, and here Gazprom and Statoil are already learning hard lessons in energy markets. Container shipping in North America is robust on all its many ports, which are connected by rail. If Russia appears to be developing its passage quickly, it's because they must. This too we address in time.

In the Eastern Hemisphere, there is only one such route, properly called the Northeast Passage, which begins at North Cape, Norway and ends at the Bering Strait and nearly all of which lies offshore the Russian landmass. Russian legislation (and tradition) defines part of this, from the entrance to the Kara Sea off Novaya Zemlya across Siberia to the entrance to the Bering Strait, as the "Northern Sea Route." In the Western Hemisphere, the Northwest Passage begins at the entrance to the Labrador Sea and the Bering Strait. Canadian legislation calls the Nunavut passages the "Canadian Northwest Passage" and considers them part of Canadian internal waterways.

Comparing the two passages should be approached with circumspection,

particularly in terms of ongoing climactic change and relative strategic importance, both of which will change markedly over the coming decades. Both passages have been open intermittently since 2005. Neither is yet sufficiently viable for commercial use at present. Each is likely to develop at different timelines, with different global consequences. Ultimately, the viability of either will depend on the development of port, rail and road infrastructure, in turn a function of both commercial and national strategic motivations for developing it. In these considerations, the two passages are very different.

There is, secondly, direct transit to the Arctic, which rarely gets a footnote in studies these early days, but this too is a matter of analytic experience. *It is commonly observed that the Arctic is the least known of all the world's oceans, which is decidedly not true. Great treasure in rubles and dollars has been spent mapping every fathom curve in large parts of the Arctic. Some passages have been secretly transited by submarine for many, many years, and these are not chosen by accident.* They will have economic parallels in the future.

NORTH ATLANTIC SEABOARD AND BARENTS-KARA

The third type of transport can be anticipated on a hemispherical and regional level. Today we think of the world in equatorial projections, which tends to divide it into distinct north and south and east and west divisions. As the Arctic ice caps melt, however, access into the Arctic, to Greenland and the Canada inland seas is greatly facilitated. The physical and economic geography that results will place an extraordinarily large amount of the world's commodities, wealth, markets, and transport infrastructure within a relatively small footprint. *This new North Atlantic Seaboard creates new and direct economic and transportation ties among Norway, Denmark, and Great Britain in Europe, and Greenland, Canada and the US in the Americas, with Iceland in the middle.* This is a long and familiar geography writ very large by the new sea lanes it creates. The North Atlantic Seaboard countries have a far greater historical, political and economic affinity than the European Union. Moreover, as we shall explore, they enable deep transportation infrastructure to the Pacific, which is not possible in Eurasia at present. In Europe, the Baltic Sea takes on a new importance, if its infrastructure is developed. Otherwise, as along with continental Europe, it is isolated from the Seaboard and the Far East by lack of landward transport.

Similarly, the area melting creates a new greater region from the Barents Sea to the Taymyr Peninsula, enclosed in the north from Spitsbergen to Severnaya Zemlya, and bordered by the Russia and Finland. The Barents-Kara will surely be one of the world's future great regions. When viewed from the south on a

map without undersea features, much of its potential is obscured. Studying it from north, however, the region immediately comes into focus. From sea, either slope of Ural Mountains is accessible, and that long chain ceases to be an obstacle between east and west. The White Sea and the Gulf of Ob reach deep into the continent, and there are ample natural harbors. This area will open faster than any other area on the Arctic because Russia, having drilled its onshore resources increasingly dry, must open it or collapse.

The great problems are that, landward, in Russia there is no modern physical, virtual, or financial infrastructure. Viewed from this north perspective, Murmansk is a poor choice for a future world-class Arctic port. In a warm world, especially for Norway, Sweden and the EU, a far better choice is Varangerfjord and Kirkenes. To allow Murmansk to develop as the Arctic port of choice is to miss the opportunity of a century, and isolate Western Europe from the Arctic while increasing its reliance on Russia. As we shall see presently, however, the potential for these two regions in different hemispheres is distinctly different.

MONEY AND PROFITS REIGN

For all of these reasons, *we choose to explore the Northwest and the Northeast passages more expansively than is the present common practice. Our reasoning in this is straightforward: by mid-century, at least, both will emerge as important and likely quite different global and regional communications lanes.* It is an historical fact that while nearly all new routes are initially discovered and charted by government-dispatched explorers and military expeditions, but their subsequent economic development, and ultimately their value is determined by speculative entrepreneurs. Whenever the ice melts, and regardless of the use of the passages today, unless there is significant profit placed against risk of development, the passages will be empty. This is the meaning of the three prerequisites for maritime trade we addressed in the earlier chapter, worth repeating in sum:

1. Maritime transport is only worth the risk of capital investment when extraordinary profits can be made from distant trade, which can be reached efficiently by sea.
2. Maritime transport arises when profits can be realized merely from the transport of the commodities, which means demand for them must be very high, high enough that big profits come in a short time. The primary consideration is amortization. Time at sea is dead time. The longer the route, the fewer cycles of profit. To make money, ships need to be in constant transport, dumping cargos quickly to get more. This condition reflects an

underlying unidimensional obsession found the maritime trades: high risk, the necessity for quick returns to service that risk.

3. Maritime trade depends of stable contractual condition and a safe world for ships at sea. This has two significant implications, each with consequences. One need is economic stability. men do not go down ships without high confidence they will make money and a lot of it. They do not go to see at all is the risk of ship loss is high.

The difference between good nautical routes and good maritime trade routes is the latter is concerned with cargos and destinations and only incidentally with transit. For the Arctic passages, there are a number of implications that require considerations beyond which passage will melt first or which had the most traffic in the past year. The passages are not in competition. The products are. Nickel mined in northern Ontario, which was shipped to market in China by sea through the Northwest Passage for the first time in September 2014, must present a better value — in some combination of price, quality and quantity — than nickel shipped from Nor'ilsk, Australia, Indonesia, New Caledonia or the Philippines. A host of considerations beyond sea ice melting rates go into such a calculation.

THE NORTHWEST PASSAGES



Figure 11. Northwest Passages.

SOVEREIGNTY

Three countries have the largest sovereign territory amongst the routes: the US, Canada, and Greenland. In addition, France, by virtue of the tiny archipelago of Saint Pierre and Miquelon off Newfoundland, which is a French overseas collectivity, has interests at the eastern entry. It also has a deep and abiding relationship with Quebec, a former French colony that has three times put vote for succession to its citizenry and narrowly lost. Canada and France, therefore, play well together. Denmark, as a result of its relationship with Greenland, is in dispute with Canada over the tiny, uninhabited Hans Island, which lies astride the Nares Strait channel that separates Ellesmere Island from Northern Greenland. As it happens, this is a vital channel and a potential, at least, for confrontation exists. Canada claims the passage as sovereign territory – internal waters. In practice, this is an indefensible position for four reasons:

1. It does not have the military, diplomatic, or economic ability to deny passage for any length of time, though it certainly will be able to board and intern shipping. Russian intrusion will certainly be met with immediate and full response. This is a hard core issue in Canada that would topple a government quickly, and knowing this, both political parties are supporting funding defense forces at a slow but steady incline. Canada has the financial, operational and technical wherewithal to do so. Russian naval forces have declined beyond obsolescence, and so there is no real risk military response. A saber drawn there would be very rusty indeed.
2. There is a long history of diplomatic solidarity with the US, including nearly seven decades of overt and covert co-operative military use. From time to time, the citizenry on each side decries the other in a sort of social antler clashing, but each depends on the other and their common infrastructure is inextricable. The US will neither provoke nor support Canada's claims, though an outsider pressing Canada hard would be met with the US force. Neither country wants the issue played out.
3. Canada's military cooperation extends beyond the US to NATO, and the Canadian Arctic Archipelago is strewn with military outposts. Greenland too has a long military history with NATO. While Putin postures, it is unlikely the bases that lie directly over the Russian landmasses – and were built for that purpose – would become a matter of allied debate just now.
4. Finally, international law and practice is clear in precedent and practice about ships in transit from one international destination to another. If

Canada pressed its position, and lost it would be politically catastrophic internally. If it pressed its position and won, it would create a first new precedent reversing the history of centuries of Admiralty law and there are a lot of countries that would like to follow that opportunity.

THE NORTH AMERICAN ARCTIC

It is a mistake of great oversimplification to focus on the melting North American Arctic in simplistic terms of opening “Northwest Passage.” For one thing, there are six different passages from the Atlantic to the Pacific, and several involve quite different regions not just alternative straits, which is largely the condition in the Northeast Passage. Between the Barents and the Kara Seas, for example, there are three options: under, over, or through the islands of Nova Zemlya, but they are all navigational options leading to the same place. This is not the case in the Canadian archipelago, where choices at Amundsen Gulf in the west and Lancaster Sound in the east lead through different regions. As the Arctic melt proceeds, these regions will slowly grow in regional, continental, and global importance — especially the routes into Hudson Bay, between Greenland and Canada, and at the MacKenzie Delta. Each region will emerge on different climactic timelines. The Arctic is at its most savage and stubbornly frozen along the northern coasts of Queen Elizabeth Islands. They will emerge on different economic timelines. Because North America has ample transportation infrastructure on land, as well as the St Lawrence seaway, and the Panama Canal, and, importantly, a highly diversified economy, the economic necessity to develop the Arctic passages is not pressing as it is in Russia.

It lends perspective to think of the future North American Arctic (and on a smaller scale, the Barents-Kara region) as one would today of the interconnected island region of Malaysia, Indonesia, and Papua-New Guinea. And to remember, that the North American Arctic is considerably larger.

Melting opens an immense region of waterways and inland seas to direct maritime transit, and in North America, they reach very deep into the continent. Hudson Bay and the Foxe Basin alone are larger than the Mediterranean Sea. Baffin Bay, the Davis Straits and the Labrador Sea are larger still than either area. Except for the East and South China Seas areas and the Caribbean, nowhere is there a comparable region.

Moreover, the largest islands in the world are suddenly coming available. Baffin Island is larger than Sumatra and more than twice the size of Great Britain. Victoria Island would hold all of the islands of the Russian passage, including Novaya Zemlya, and still have room for Sicily, Sardinia and New Caledonia. It would hold Sakhalin Island, Cuba and Sri Lanka all. Iceland and Mindanao could

be squeezed into Ellesmere Island. Taiwan, which has 23 million inhabitants, would fit easily in Melville Island, which has none.

As with the North East Passage, It is useful to think of these not as they are now, or in ten years, but across a sequence of scenarios that will unfold as the melting continues. There is not a port or a passage on either side of the Arctic suitable for commercial use of bulk carriage, dry or liquid, but there are on both sides great harbors and specific destinations that will command attention and investment. It is idle public relations to say that Murmansk or Churchill will be the great port of the future — neither is worth a drunken sailor’s weekend liberty as they sit. All modern ports require land for wharfs and warehousing, power, deep draft, shelter and above all, hinterland connection. The most successful ports in the world today have been built from ground up in the past 25 years. One should look at the Arctic with the eyes of combined perspective of a maritime surveyor, an investment banker, and an industrial engineer.

GEOGRAPHIC SUMMARY OF NORTHWEST PASSAGE REGION

As with the Russian passage, the passage is best understood in the larger context of the extended geography within the immediate entrances to the passages. Without that context, there is simply a recitation of straits. A quick summary is useful first before proceeding in detail. There are seven contiguous regions, each linked to the others by waterways. In order from the Atlantic, they are:

1. To the south, the Canadian Maritimes, Cabot Strait, and the Gulf of St Lawrence. This is the gateway into the interior, extending about 3,800 kilometers to Lake Superior at the western end of the Great Lakes Standing off the Gulf are Newfoundland, Nova Scotia, Prince Edward Island, and New Brunswick.
2. There is the immense oceanic intrusion created by the North Atlantic, Labrador Sea, Davis Strait and Baffin Bay. It is enclosed by Greenland on the east and Newfoundland and Labrador, Baffin Island, and Ellesmere Island to the west.
3. There is a vast inland sea made by the Hudson Strait, Foxe Basin, Hudson Bay and James Bay. It connects deep into North America, by pipeline, canal, rail, air, and road.
4. Off Baffin Bay, between Devon Island and the north tip of Baffin Island,

the entrance to largest passage west, Parry Channel, is gained at Lancaster Sound. North of Parry Channel are the Queen Elizabeth Islands, the largest of which is Ellesmere Island.

5. Immediately northwest of Foxe Basin and south of Parry Channel, two large and remote continental extensions reach northward: the Melville and Boothia Peninsulas. These enclose and largely isolate the long and narrow Gulf of Boothia.
6. West of these peninsulas and south of Parry Passage another large discrete region is centered on Victoria Island and includes all of Western Canada's continental shore. Much of the country's mineral and petroleum wealth yet unexploited is here. Further westward near the US border is the MacKenzie Delta.
7. Between the MacKenzie to the Bering Strait, lies the Alaskan North Slope, the Beaufort Sea, and finally the Chukchi Sea. Below the Bering Strait, the Aleutian Islands enclose the Bering Sea, which stands above the North Pacific.

THE TRANS-POLAR ROUTES IN BRIEF

All but one of the six routes involves a long straight voyage without significant course change (from the North Atlantic) through the Labrador Sea and the Davis Strait into Baffin Bay. On the Canadian side, there is the mainland Labrador coast and that of a single great island, Baffin Island. To the east is Greenland. At the top of Baffin Bay, a sharp course change to the west follows the 74th parallel nearly straight as a navigator's ruler through a long, wide and deep channel that divides the Canadian Archipelago into two sets of islands. This is the Parry Channel, the first and largest of the full passages. It is comprised of four segments: Lancaster Sound, Barrow Strait, Viscount Melville Sound, and M'Clure Strait. Above the Channel, the islands to the north, collectively known as the Queen Elizabeth Islands, face the Arctic currents and winds full force and are nearly always frozen over.

The four large southern have no collective name, but colloquially are called the southern archipelago. From east to west, after Baffin Island, these are Somerset Island, Prince of Wales Island, Victoria Island, and Banks Island. Through these there are four passages southward from Parry Channel that may be taken to the continental coast. The sixth passage, rugged and narrow, emerges from Foxe Basin and is gained from the Hudson Straits.

THE PASSAGES DETAILED

THE WESTERN NORTH ATLANTIC

The busiest deep-sea routes in the world have long been the passage across the North Atlantic between Northern Europe and North America. Greenland, the first landform of North America, lies north of those routes of main routes. The Canadian province of Newfoundland and Labrador form the western approaches of the North Atlantic. Airline passengers often see the long rugged Labrador coast below with on a clear day.

For ships, the island of Newfoundland, and its capital and port of St. John's, is the first port on many of the great circle routes from Europe, but Halifax, Nova Scotia to the south is much and serves as Canada's best Atlantic port. Both have long histories and are modern, well-connected cities. St. John's is a small but modern ice-free port that can handle ships up to 500,000 deadweight tonnage and regional container shipping. A city of 100,000, it has a long history of association with fishing, but in the past two decades has grown to service the sizable Labrador Sea oil industry. Halifax is a city of about 450,000 people on Nova Scotia with a large commercial harbor, shipyard and naval base. It is a major staging port because it has a deep, wide and ice-free harbor, and lies about two days eastward of other American ports on the Europe routes. It has a long history of both commercial and naval use and was a major assembly point for Lend-Lease convoys during World War II. It has direct access to the Canadian National Railway and from thence into the rest of Canada and the US railways.

South of Halifax at Cabot Strait is the entrance to the Gulf of St. Lawrence and the long Saint Lawrence Seaway. It is a system of locks, canals and channels that permit ocean-going vessels to travel from the Atlantic Ocean to the Great Lakes, as far inland as the western end of Lake Superior. Along the Saint Lawrence are Canada's largest cities, its capitol, and its largest and busiest ports, including Quebec City, Montreal, Toronto and Duluth. The Port of Duluth is a major gateway for Canadian grain and ore, but in recent years, as European imports have declined, those cargos have begun to ship more frequently to Asia and South America. Much of that cargo now moves by train to west coast ports and south to the Gulf Coast for loading there, and a growing amount, though still small, is shipped from the Hudson Bay port of Churchill.

GRAND BANKS AND FLEMISH CAP

Off the southeastern coast of Newfoundland, the cold Labrador Current meets the warm Gulf Stream over a shallow projecting extension of the continental shelf. The mixing of these waters and the shape of the ocean floor churns bottom nutrients to the surface, which creates perfect conditions for plankton and plankton-feeders. These conditions created one of the richest fishing grounds in the world. Here two of the world's greatest fishing areas once existed: the Grand Banks, and to the east, the Flemish Cap. The Grand Banks is a highly productive region, supporting huge schools of pelagic fish and thirty species of feeding marine mammals, including Beluga whales, the endangered Northern Right whale, and Humpbacks. For four centuries immense numbers of cod were caught here, but like much else, are caught no more. The harvest of cod ended abruptly in the 1990's despite a long and largely fruitless attempt, including an outright ban, on the part of Canada to bring it back from near collapse. The cause was not gradual, but due almost entirely to large factory fleets, which used drift nets: In 1968, the cod catch from the Grand Banks was 810,000 tons; in 1974 it was 34,000 tons. Cod is only one of many species that is at all time historic low levels today: the redfishes, haddocks, plaice, and many pelagic fishes, especially capelin, are all swimming toward extinction.

LABRADOR SEA

From the Northern Atlantic approaches to the top of Baffin Bay, there is a wide, deep and continuous oceanic body of spanning over 30 degrees of latitude — about 3,200 kilometers in length — and about the size Scandinavia and the Baltic Sea combined in area. Looking northward from the Atlantic, the geography becomes apparent. Once into the Labrador Sea, a nearly strait northwesterly course eventually will lead to the head of Baffin Bay. A course change to the west leads to Parry Channel, while a northeasterly course leads through Nares Strait directly to the Arctic Ocean. Long before this, at about 600 N between Cape Farewell, the southern tip of Greenland, and Cape Chidley, the northern tip of Labrador, there is the Hudson Strait leading into Hudson Bay. In short, in the lexicon of today, from the Atlantic, there are two options to hang a left and one to hang a right. Helsinki in Finland and Magadan in Siberia are co-lateral.

The Labrador Sea is about 1,000 kilometers wide at the Atlantic end and separates Greenland from Newfoundland and Labrador from Greenland. The northerly West Greenland current, a spinoff from the Arctic water coming downward along the east coast of Greenland, and a southerly current out of Nares Strait flow on opposite sides, creating of a general counterclockwise flow of water that emerges in the Atlantic as the Labrador Current.

On the southern Labrador coast, the long Goose Bay inlet leads to the town of Happy Valley-Goose Bay and an important Canadian Air Forces Base Goose Bay, Canada's main eastern base. It has been in use since the 1940s, and has very large and modern infrastructure. The runway is long enough that a 747 carrying the NASA space shuttle has used it. The US, Italian, and German fighters have been stationed at the base along with Canadian and British air forces. The Trans-Labrador Highway, part of the interconnected Canadian highway system, which also connects to the US Interstate system, services the town and the air base.

Case: Off-Shore Petroleum

Large petroleum basins exist from Grand Banks area north into Baffin Bay. Newfoundland and Labrador Wells have been producing since the late 1990s. These are serviced by the port of St John's. It is estimated that far more recoverable reserves of 4,6 billion barrels of oil and 18,8 trillion cubic feet of natural gas exist in the basins of Grand Banks alone, and that those basins have a common geologic origin with others along the West Greenland coast and perhaps out into the Lincoln Sea above Nares Strait. But exploration has proven expensive and mixed in success. Since the development of the oil sands fields in Alberta, exploratory drilling has fallen off amid environmental concerns that are justifiably high.

As with all matters in the petroleum industry, however, multiple factors complicate the situation. Supermajor energy companies are valued by proved reserves, creating a need for exploration even when prices are low. Shell has major troubles in this regard. In 2005, the company overstated its reserves by 22 percent, dropping its stock overnight when the US and Britain assessed a very public \$150 million fine. Shell survived to become the world's largest company in the world by 2012, but a billion-dollar effort to start drilling in Alaska that year ended in disaster when its rig was lost at sea and negligence again was cited. With the sanctions in Russia in place, Exxon has had to pull back from the Kara Sea, and BP is trying to straighten out its Russian investments with Rosneft. The upshot is reserves are dwindling and so are prices, crashing energy stocks around the world. Little can be done about prices, but the supermajors have to drill. This may mean that West Greenland and Labrador Sea exploration may resume despite the cost.

DAVIS STRAIT

The Labrador Sea narrows to about 950 kilometers at Davis Strait, which is the world's broadest strait. The geology of the strait is complex, made so by the contortions of divide here between the North American plate the Greenland plate. At the narrowest point, its submarine topography consists of an undersea ridge extending from the coast of Baffin Island to Greenland. The shallowest waters in the strait are found along this sill, from 350 to 550 meters deep, before plunging down to abyssal basins on either side. Some of the greatest depths in the eastern Arctic are reached (3,660 meters) in the southern end of the strait. The surface waters are strongly affected by counterclockwise-flowing currents, and it experiences quite high tides. Because of the narrowing of the Strait, the southerly Arctic flow from the Nares Strait and Baffin Bay pick up speed here and can exceed velocities of 20 kilometers per day. On the east side, the warmer water of the West Greenland Current also becomes narrowed, creating a difficult passage with heavy ice movement and icebergs along the western shore and more open water along the Greenland side.

GREENLAND

Due east is Nuuk, the capital of Greenland. Greenland, which is melting quickly, is also rapidly emerging as a very interesting place. With each passing of the overhead satellite constellations have now conduct multispectral analysis of the Earth below, the bedrock under the ice sheet is looking more exotic. It is possible that there may be multiple islands under the ice, and it is well established that a long canyon, twice the size of that of the Grand Canyon in the US Arizona is there. Although it is a part of the North American plate, it sits atop its own subplot, which "floats" on the other. Large canyons and rifts line its east and west coasts, and its proximity to the Mid-Atlantic Rift, coupled the greater rotational torque of high latitudes, have meant that Greenland's movements over geologic time have been more than anywhere else on the planet and for a much longer time. Whatever is underneath the cap is going to be unique.

The Greenland ice sheet — more than 3 kilometers thick and broad enough to blanket an area the size of Mexico — shapes the world's weather, matched in influence by only Antarctica. Inside the ice cap, snow that fell a quarter of a million years ago is still preserved. Temperatures dip extremely low below zero, and ground winds can top 300 kilometers per hour. A simplistic calculation is that the ice is so massive that should all of the ice sheet ever thaw, the meltwater could raise sea level 6 meters and swamp more than a few of the world's coastal cities. Dumping massive amounts of fresh water into the ocean's current engines will have very complex

consequences. Since 2012, a record year for melting, Greenland's three largest outlet glaciers have started moving faster. The near term data are confusing; in some years, the amount of ice has increased. However, in recent years, the biggest glaciers, the Kangerlussuaq Glacier the Helheim Glacier on the east coast and the Jakobshavn on the west, movement has surged, so that in some areas in some years, it has doubled in pace. It now appears to be moving to the west about half a football field every day. In all, twelve major outlet glaciers drain the ice sheet the way rivers drain a watershed. If they all slide too quickly, there is a possibility that, perhaps years from now, they could begin to collapse suddenly and release the large sections of the sheet into the ocean. The accelerating ice flow has been accompanied by a dramatic increase in seismic activity.

Greenland, like Antarctica, is one of the rare remaining formations on earth where at the underlying economic geology still remains poorly understood. This is changing rapidly in both places, due in part of exploratory drilling. In the main, however, it is new technology that is making a difference in geologic exploration around the world. New spectral sensing technologies, from very long acoustic wavelengths to very high electromagnetic frequencies, can be employed on Earth and in space to map and make mapping inferences about lithographic strata. Constantly increasing computer capacity is enabling constantly increasing detail and manipulative capability. Coupled with these, a rapidly increasing and increasingly detailed atlas of world tectonics and paleotectonics is emerging, which allows high fidelity simulations of plate movements over a variety of geologic timeframes. Around the world, the new technologies lower the cost and increase the precision of exploratory drilling. Nevertheless, the massive ice caps and the remoteness of the areas make the cost of exploratory drilling still very high. In Greenland, this is mitigated by spectacular ice-scoured outcrops along steep fjord walls that expose rock layers that elsewhere could be found only by drilling.

Greenland's existing mountain chains are old, arising before the convergence of Pangaea, but its proximity to the Mid-Atlantic Rift has also caused major volcanic successions 60-55 million years ago on both coasts. The entire plate on which it rests has journeyed from the southern hemisphere through the tropics to its present polar position since the Pangaea breakup. The underlying craton is made up of some of the oldest rocks on the face of the earth. The central basement shield is known to be composed of gneiss complexes and belts of metamorphosed sedimentary and volcanic rocks that came into existence during mountain-building episodes in the very distant past — from 3,800 to 1,600 million years ago. All over the world, this kind of geology means metals and gems, as well as rare earths. Exploration is still quite limited, but there are many finds, which make Greenland's potential all the more anticipated.

Petroleum, as we mentioned above, is a different matter. It is clear that around

the margins of the basement shield — on the coastal areas and in the ocean basins around Greenland — thick sedimentary deposits accumulated in extensive basins. The US Geological Survey, which is the authoritative source on Arctic reverse, assesses probably of major finds in much of Greenland's offshore basins at 100 percent, a rare tally. Licenses off the East Greenland coast were granted in some of the most extreme offshore drilling conditions in the world, created by the layered depths of fast moving and powerful current there and exceedingly stubborn ice. One of the companies, Cairn Energy, was widely reported to have spent nearly \$1,4 billion and come up dry, while at the same time incurring injunctions from Greenpeace over its unwillingness to publish spill plans. In 2013, the new government of Greenland placed a moratorium on further licensing in the country.

BAFFIN ISLAND

In a warmer world, the geography of this island, the 5th largest in the world, is likely to be a prerequisite for school children around the world. It is the key to understanding much of the Northwest Passage and guards all the main passages found in archipelago. It is a long and mountainous island — 1,500 kilometers long and 200–700 kilometers wide. Geologically, Baffin Island is the far edge the Canadian Shield, which tilts upward on the east to form a mountainous spine, sloping away into plateaus and lowlands in the west. But for the ice, it is both a naval officer's and a ship master's dream.

In the north, the Lancaster Sound between Baffin Island and Devon Island is the entrance the deep water Parry Passage west to the Pacific. There is a desolate plateau comprised of the Brodeur and Borden peninsulas, which are separated by Admiralty Inlet, one of the world's largest fjords. It is at the Admiralty Inlet that the Canadian government is building its largest Arctic base, including a large naval port facility. From there, the base commands all shipping lanes, whether northward along the Nares Strait or westward along the Parry Channel. The US air base at Thule, Greenland sits across Baffin Bay at the entrance to the Nares Strait.

On the east coast of the island, there are very deep and protected bays at Cumberland Sound and Frobisher Bay, which is named after the ill-fated English explorer who landed there three times in the late 1600s in search of Cathay. Frobisher Bay is 230 kilometers long and varies in width from about 40 kilometers at its outlet to roughly 20 kilometers towards its inner end, which shelters the city of Iqaluit, the territorial capital of the Nunavut. In World War II and during the Cold War, its civilian airport was a major air base.

On the south, the Hudson Strait is reached by passing west of Resolution Island. At the western end of the strait, there are the entrances to Canada's two

large bays. The smaller, to the north, is the Foxe Basin, which is created by the sheltering lee of Baffin Island against the land masses of the Melville Peninsula and Southampton Island. It is enclosed almost completely with a surface area of about 6,000 square kilometers. Within it is an archipelago of smaller islands facing onto fjords. In the latter half of this century, no doubt, it will be prime real estate. Few places in the world are more beautiful, cleaner, more accessible, and, above all, newer, for the future wealthy than Foxe Basin. At its northwestern extremity, the Fury and Hecla Strait, too small for commercial vessels, is the only other westerly passage in the archipelago.

HUDSON BAY

To the south, is Hudson Bay and its extension, the James Bay, which together have a surface area of 1,2 million square kilometers and drain almost 4 million square kilometers that includes parts of Ontario, Quebec, Saskatchewan, Alberta, most of Manitoba, southeastern Nunavut, as well as parts of North Dakota, South Dakota, Minnesota, and Montana. These two bays are the largest bodies of water in the world that seasonally freeze over each winter and become ice-free each summer. In Hudson Bay, the ice cover starts to form in northern areas by late October and continues to grow until a maximum cover is reached at the end of April.

Taken together, Foxe Basin and Hudson Bay are enclosed seas larger than the Mediterranean Sea, and they open onto the enclosed waters of Baffin Bay, the Davis Straits and the northern Labrador sea, which makes them, by far, the greatest body of sheltered waters on the planet. Hudson Bay's southern shore is a vast subarctic wetland underlain by peat, much like the West Siberian Plain in Russia. Many wide and slow-moving rivers flow through this area toward the salt water of Hudson. It is largest wetland in North America, and one of the largest in the world.

To the west, are Manitoba, Saskatchewan, and Alberta, which are Canada's three long productive prairie provinces. All three have diverse economies, collectively producing the bulk of the country's energy, mining and agricultural industries. On the Manitoba shoreline, there is the Port of Churchill, which is the present and likely future best port for Canadian exports northward. Churchill can handle Panamax ships today, and there is rail connectivity into the North American rail system. There are also substantive plans for oil pipelines from Alberta, as well as the potential for LNG. It has what few Arctic ports possess, shelter, depth, and rail connectivity southward, while adjacent to large economic production areas. PetroChina Co. Ltd., Sinopec, CNOOC Ltd., China Investment Corp. and other state-owned enterprises have made a raft of big bets — over \$30 billion — on

oil sands projects, shale developments and domestic companies in the prairie provinces since 2005. The greatest problems for Churchill is internal competition with rail and the long landform of Baffin Island that must be traversed for passage westward. For maritime passage east to the Atlantic to Europe, the Middle East, and Africa, however, it has great potential in that it opens all of the Canadian resources to open ocean transit.

Ontario and Quebec lie southward. Southern Ontario, along the Great Lakes region, is Canada's economic center of gravity. It is its largest manufacturing center and a major transportation hub of all modes. The forest industry, especially pulp and paper, is large. Mining is significant across the entire region from the western Great Lakes to the tip of Labrador, owing to the unique geology of this part of Canada. Hudson Bay is at the center of the Canadian Shield, an extremely ancient core of the larger North American Craton, the perimeter of which extends east to the Labrador Sea and the Davis Strait, south to an area below the Great Lakes and northwest to the Arctic below Victoria Island. The shield was once part of a stupendous mountain range, far higher than the Himalayas and containing some of the largest known volcanos. (In the 1930s, an earthquake measuring 7.3 occurred in the Davis Straits.) Very large deposits of iron, nickel and chromite exist.

Hudson Bay's geology is exceedingly complex and unusual. There are large gravitational anomalies here, as well as number of large ancient igneous provinces and mantle plumes similar to but smaller than the Siberian Traps across the Arctic in Russia. In the very distant geologic past, the area surrounding the Hudson Bay was part of a landform sutured together from at least nine smaller pieces of primordial continents. Thus, the Hudson Bay area is contorted by opposing geomechanical forces. Underneath it, there appears to be a major downward convection currents of the Earth's mantle, which acts to pull the crust downward, creating a great basin. This is countered by the relatively recent geological trend of glacial retreat, from which the crust rebounds upward.

BAFFIN BAY

A little more than halfway up Baffin Island, the Davis Strait begins to open into the broader and deeper Baffin Bay. At the top of Baffin Bay is the choice westward through Parry Channel or northward into the Arctic Ocean via Nares Strait. Like the rest of the area, its geology is unique. The North Magnetic Pole has wandered underneath here to its present position at Ellesmere Island, where it seems to be moving erratically but steadily across the Arctic Ocean toward Russia. Prior to the launching of GPS, magnetic compass corrections grew larger and changed more frequently the further north into the transit.

At 700 N on the Greenland coast is the large island of Qeqertarsuaq, which shelters the large Disko Bay. Qasigiannguit and Ilimanaq are the main settlements in the southeastern inlet, just south of the outflow of Ilulissat Icefjord. At its eastern end is the Jakobshavn Isbræ glacier, the most productive glacier in the Northern Hemisphere, which flows at a rate of 20–35 meters per day, resulting in around 20 billion tons of icebergs calved off and passing out of the fjord every year. Icebergs breaking from the glacier are often very large (up to a kilometer in height) and emerge into the open sea, where they flow south into the Atlantic Ocean. The iceberg that sank Titanic is likely to have come from Illulissat.

NARES STRAIT DIRECT TO THE ATLANTIC

Transit northward leads to the Nares Strait between Ellesmere Island and Northwestern Greenland and emerges into the Arctic Ocean via the Lincoln Sea. This is an extremely important the US, Canada and NATO passage that provides the most direct route from the Arctic into North America. Two very important military bases are in the area: Alert and Thule. The passage has been used many times by submarines and military surface ships, and is deep and of good width. Absent the passage, submarines must take routes far to the east of Iceland or west through the Beaufort Sea otherwise.

Case: Thule Air Base

Thule is at the southern entrance to the strait on the Greenland coast, near Dundas, which was a former trading station founded in 1910 by the Danish explorer Knud Rasmussen. It is a key and highly classified US air base that was constructed in the 1950s as part of a ring of NATO bases and stations in Greenland, all code-named “Bluie.” Thule — the US Peterson Air Force Base — is Bluie West 6. In the 1950s, it was built at great expense and through a huge engineering effort in which more than eighty ships, including amphibious landing craft, were sent northward along with thousands of workers. The US Air Force Chief of Staff, the civilian head of the Air Force, and the head of its Strategic Bomber Command all arrived onsite to inspect its construction. In the context of the time, the base would have had political value for the Air Force, which was lobbying hard for its expansion as a nuclear force. As with other Arctic bases, it served as a staging and refueling base for B-52 bombers, one of which crashed at Thule in 1968 carrying four hydrogen bombs and resulted in a significant contamination of plutonium from the explosion of their conventional detonators. Camp

Century, an entire underground city carved into an ice cap with its own portable nuclear reactor, was built about 150 miles away. The US Air Force conducted regular long reconnaissance flights over the Arctic from Thule to the Siberian coast, from the Lena Delta to Murmansk.

The base has never declined, though its role as a bomber base ended with the development of more sophisticated ballistic missiles and the deployment of ballistic missile submarines. *Its publicly announced missions generally have followed the technology evolution of strategic warfare, including a key role as a ballistic missile early warning radar site. Today, its public mission is to host a global network of space sensor and satellite control facilities.* It maintains a 10,000 feet runway that handles aircraft of all types. Officially, more than 3,000 flights occur each year, but a significant surge capability exists beyond that. Since submarines have been known to use Nares Strait into the Arctic, the base probably has a mission that extends to naval submarine support. Soviet intelligence ships routinely entered nearby waters, and on several occasions cut underwater communications cables — a not uncommon practice by all sides.

Alert, at the northern tip of Ellesmere Island, is a military communications listening post and a key weather station. It is the closest point in North America to the north of the Russia, closer to Moscow than it is to Ottawa.

In a much warmer world, Nares Strait will become an important Arctic passage: it is best and most direct route to the Arctic from deep inside the North American continent — Hudson Bay or the St Lawrence. Today it is open only in the warmest months, usually not until August, although in June 2009 the Greenpeace vessel *Arctic Sunrise* made a transit.

LANCASTER SOUND TO THE BEAUFORT SEA

The other choice at the top of Baffin Bay is the entrance route west into Lancaster Sound. Five of the six Northwest Passages begin here. In the warmest of worlds, full passage can be made nearly due west through the Barrow Strait, Viscount Melville Sound, and M'Clure Strait. From there, a course due south will hug the coast of Banks Island and lead to the opening of the Amundsen Gulf and the MacKenzie Delta. This course is called the Parry Channel, and it is the natural dividing line within the Canadian Arctic Archipelago, separating the Queen Elizabeth Islands from southern islands and the mainland.

Ice conditions become progressively worse from east to west. Lancaster Sound and Barrow Strait are dominated by multiyear and first-year ice floes but Viscount Melville Sound and M'Clure Strait can have heavy concentrations of multiyear ice

floes. Freezeup in Lancaster Sound and Barrow Strait usually begins in October, and they are frozen solid by early November. Viscount Melville Sound usually freezes by late-September although ice may remain in motion until late November. Until the last decade, M'Clure Strait usually remain clogged with ice all year.

ICE ISLANDS

The Beaufort Gyre, which annually draws water from the North Pacific and in concert with the prevailing winds slowly rotates clockwise around the Western Arctic, is an obstacle to direct passage north of Banks Island. The clockwise rotation causes the immediate south-westward drift of ice islands calved from Ellesmere Island's northwest coastline. The ice islands usually hug the coastline of the Queen Elizabeth Islands as they make their way toward the Mackenzie Delta. The common drift pattern is for the islands to move northwest following the Alaskan coastline, then move northeast toward the North Pole, and finally back along the coast of Ellesmere Island. During the Cold War, the Soviets used at least six of the islands as mobile listening posts. The US is known to have used several. One, called Fletcher's Ice Island, was used between 1952 to 1978, with a gradually increasing group of bases on it, a small runway, and power plant installed. Aircraft from Thule and Point Barrow resupplied it, as did US nuclear submarines. Another, named ARLIS II, was found in 1961 off Alaska, measuring about 6 kilometers by 3 kilometers. It was manned throughout its drift across the Arctic for years before it finally drifted through the Fram Strait in the Atlantic. More than 300 personnel were stationed on it.

Ships emerging from the M'Clure Strait are in the pathway of the ice and face the direct winds of the gyre, which is a formidable problem presently, but will give way gradually as the Arctic continues to melt. In the long term, the straight course from Lancaster Sound to M'Clure Strait is clearly the best commercial route, but the uncertainty of the Arctic melting makes short- and mid-term investment in the route risky.

PRINCE OF WALES STRAIT

The best commercial alternative, probably for decades to come, is to cut the Parry Passage short before Banks Island and proceed southward through the Prince of Wales Strait into Amundsen Gulf, where the prospects for a future large Arctic port are manifold. The Prince of Wales Strait is about 275 kilometers long and generally about 20 kilometers wide with depths reaching 160 meters at the southern

end and becoming progressively shallower towards the northern entrance. The southwestern orientation prevents prevailing winds from driving heavy pack ice down the strait leaving it primarily covered with locally formed ice that breaks up more readily, leaving a reasonably clear channel. Banks Island provides a continuing lee in the passage that begins all the way east to the Labrador Sea.

THE REMAINING PASSAGES

Geography, if not economy, presents four other options across the Northwest Passage. Two are not commercially viable. Of these, one is the narrow Fury and Hecla Strait from Foxe Basin we have previously discussed. The other one can be made by a southerly passage at the end of Lancaster Sound, through Prince Regent Inlet into the isolated Gulf of Boothia. South of Somerset Island the very narrow Bellot Strait leads west, and further south to Amundsen Gulf.

The two remaining passages also lead to Amundsen Gulf. They are both are commercially viable as full trans-polar passages, and they will develop independently as regional passages. They begin in Barrow Strait, from which a ship may turn south along either coast of Prince of Wales Island (via M'Clintock Channel or Peel Sound) and proceed to the mainland coast and westward into the Amundsen Gulf. The small port of Cambridge Bay, on the southeast coast of Victoria Island, is large stop for passenger and research vessels on the route. Coronation Gulf, further west past Dease Strait is at the head of the western edge of the igneous formations of the Canadian Shield. The Coppermine and Rae Rivers, both established sources of minerals, flow into that bay. Kugluktuk is a hamlet located at the mouth of the Coppermine River with an air strip.

MACKENZIE DELTA AND BEAUFORT SEA

Once out of the archipelago, the edge of the continental shelf narrows, and the Canadian Basin is close offshore. With that there no longer is shelter from direct exposure to the winds and currents of the Beaufort Gyre, and the emergence into the Beaufort Sea presents the most difficult ice of the passage.

Off Alaska, the ice pack often moves onto the coast about mid-September and, though it may retreat northward again off the coast briefly, by late October it is hard on the coast and stays throughout the winter. On the Russian side, the archipelagos extend about 10 degrees of latitude farther north and act as a moderating barrier to the advancing polar ice pack, which allows the areas to the south of the Russian islands to remain ice free for a longer period of time than along the Alaskan coast.

The Mackenzie River Basin

The MacKenzie River flows into the Arctic west of Amundsen Gulf, creating a sizable delta. It is the last major Canadian landform before Alaska. Downstream Alberta's massive oil and gas wealth are part of the basin. It is a shallow braided river that drains an immense area of forests and mountains, as well as tundra in north as it flows from its source at the Great Slave Lake about 4,200 kilometers into the Arctic. Large as the basin is, the MacKenzie's total discharge makes it 14th in the world, but still provides only about 10 percent of the freshwater flow into the Arctic — a measure of the vast combined impact of the Siberian rivers opposite. It is slightly shorter than the Lena River, but much shorter than the Ob and the Yenesei. Unlike the Lena, however, the MacKenzie does not rush out of high elevations of distant peaks, but meanders across what was once a shallow sea. On the west, it is bound by continental divide of the MacKenzie/Selwyn Mountains, which are part of the continuous chain that runs from the Arctic to Cape Horn in South America.

On the delta itself, there are four small airports and a number of settlements. The Arctic port is Tuktoyaktuk, which is small but well-situated, and the delta presents a number of larger bays and inlets that are good possibilities for future development. Although Joint plans for the first deep water Arctic Port in the Beaufort Sea have been approved by the Canadian and the US government, ultimately Canada will have to invest here or along in the Amundsen Gulf to create a Western Arctic terminus and some naval and air presence in order to secure the area passage as a national asset. However, it has much reason to do so and many choices of sheltered deep harbors. The MacKenzie is not only the western terminus of the passage, it is the northern terminus of the vast basin that contains extraordinary wealth. Beginning at the MacKenzie Delta, where large natural gas reserves are located, petroleum basins of immense proportion, with varying degrees of production difficulty and cost, exist southward down the entire continent to the Gulf of Mexico.

The reason takes us back to Pangaea. Throughout the Mesozoic Era, the continuing breakup of Pangaea resulted in very complex plate tectonics in which the processes of formation of the Arctic and the subsidence of an ancient plate below the North American plate produced a series of inland seas. During the Cretaceous Period near the present MacKenzie delta, the Arctic Ocean spilled over into North America all the way to the Gulf of Mexico to form the largest of these warm inland seas. A shallow sea extended from the line of the present Rocky Mountains eastward to the Mississippi. For long periods of time, much of the southern US was also inundated. As these were later uplifted, the underlying rock formed massive sedimentary basins, which are the source of past, present and future petroleum reserves that span the entire continent. These lie on top of much

earlier deposits made during the Pennsylvanian Period from great fern forests that existed before the Pangaea breakup. During that time, most of North America outside the eastern Appalachian Mountains was turned into carbon swamps as the sea rose repeatedly to inundate the forests.

In Canada, the MacKenzie basin is the northern part of these sediments. Beneath its long watershed, which runs south close to the US border, are found many of Canada's greatest mineral and petroleum deposits. The Western Canadian Sedimentary Basin is a vast: 1,4 million square kilometers including southwestern Manitoba, southern Saskatchewan, Alberta, northeastern British Columbia and the southwest corner of the Northwest Territories. It is a massive wedge of sedimentary rock extending from the Rocky Mountains where the basin is 6 kilometers thick and gradually thins out to the Canadian Shield in the east at Hudson Bay. It is one of the of the world's largest reserves of petroleum and natural gas and supplies much of the North American market. In Alberta alone, the Athabasca, Cold Lake and Peace River oil sand deposits contain initial oil-in-place reserves of 1,6 trillion barrels of oil, an amount comparable to the total world reserves of conventional oil. The basin has gas reserves in excess of 4,000 cubic kilometers and is producing about 5,000,000 cubic meters per day of gas. It also has huge reserves of coal and bitumen. Southward into the US, the same inland sea deposits continue through the states of North and South Dakota, where crude oil production has outpaced even Texas, to the Gulf shore.

In addition to the oil and gas in central Alberta, within the MacKenzie basin exports include lumber from the Peace River headwaters, uranium in Saskatchewan, gold in the Great Slave Lake area and tungsten in the Yukon. In 1991 BHP Billiton geologists discovered the first of several large diamond-bearing Kimberlite pipes about 200 miles north of Yellowknife, which went into production before the decade was out.

The Western Canadian Sedimentary Basin possesses a deep and modern air, road, rail, and pipeline infrastructure centered on Edmonton, Alberta. The MacKenzie Delta itself can be reached from Whitehorse in the Yukon Territory via single-lane road, though it is rarely used. During the ice-free season, the entire length of the river is navigable, and from Hay River on the Great Slave Lake connected to the North American rail infrastructure.

ALASKA

When the Arctic begins summer melt it begins west of Point Barrow, Alaska with the northerly transport of warm water through the Bering Strait. The land gradually warms and relatively warm water begins to flow from the rivers, which speed melting and open large shore leads along the coasts of Alaska and Russia. The Beaufort Sea's surface Arctic water is about 100 meters thick and is the coldest of all the water masses in the Arctic. It is also the only layer that undergoes significant seasonal changes in temperature and salinity. These changes are in response to the freezing and thawing of the pack ice, plus the freezing and thawing of rivers in coastal areas. The Beaufort Sea becomes overlain by Pacific water as the summer progresses. The circulation of the Beaufort Sea can pack up ice against the Canadian and Alaskan coasts due to the gyre, which makes transit off Alaska the last to occur along either continent.

All of Alaska is mountainous. On the mainland, two great sets of ranges are divided by the Yukon River, which flows from the other side of the continental divide eastward across the peninsula to Norton Sound on the Bering Sea. Below the Yukon, the interior Alaska Range contains Denali, the highest peak in North America. Further south on the coast, the Chugach Mountains bend around Prince William Sound, which contains the large oil port of Valdez. To the west, the Chugach bend onto the Kenai Peninsula, home to number of cities, including the capital, Anchorage.

North of the Yukon, the Brooks Range runs across the entire state, standing like Easter Island statues onto the Arctic Ocean. Between the Brooks and the sea, a long and wide slope — the North Slope — contains the many rivers that run from the peaks northward to the sea. The northern most point is Point Barrow, which is the accepted divide between the Beaufort Sea to the east and the Chukchi Sea to the west. Halfway between Point Barrow and the Canadian border is Prudhoe Bay, which has produced oil since 1977, when the long and environmentally controversial Trans-Alaska Pipeline was completed to Port Valdez. British Petroleum operates the field and partners with Exxon and ConocoPhillips Alaska. It has produced 12 billion barrels of oil and trillions of cubic meters of gas, but entered decline after 1990. In 2002, the US Geological Survey of Arctic petroleum basins estimated additional large reserves of oil off the North Slope, but later lowered that estimate significantly saying that exploratory drilling had shown many of to hold natural gas instead. New natural gas reserves there are now estimated a 1,500 cubic kilometers.

BERING STRAIT

The Pacific egress from the Arctic is made by rounding Point Hope, Alaska, and southwesterly through the Bering Strait into the Bering Sea. Like the Barents Sea, the Bering Straits and the sea southward are exceptionally well-understood waters. On both sides, military bases, overt and covert, extend throughout. Cape Dezhnev on the Chukchi Peninsula in Russia is the easternmost point of the Asian continent and Cape Prince of Wales in Alaska is, the westernmost point of the North American continent. The Russian coast is a closed military zone.

In between, are two islands that are icons of the Cold War, Big Diomedede (Russia) and Little Diomedede (the US) about 2 kilometers apart. They also sit astride the International Date Line, so that Big Diomedede time is the day following that of Little Diomedede.

The Bering Strait is only 70 kilometers across and extremely shallow (30-50 meters) as is the northern part of the Bering Sea. South of the Pribilof Islands, the continental shelf drops off sharply, lead by three underwater canyons. Further south, the Aleutian Island chain, which is part of the Alaska, stretches across the entire southern Bering Sea. More than 300 volcanic islands make up this 1,900 kilometers chain. Two of the islands, Attu and Kiska, were occupied by Japanese forces during World War II. Several of the islands contain sophisticated military and scientific research bases. Kodiak Island, just south of the eastern origin of the chain, is home on one of the largest US Coast Guard bases. Dutch Harbor, on the Amaknak Island is a deep water, industrial port and a US Navy support base.

STRATEGIC CONSIDERATIONS

FUTURE VALUE OF THE NORTHWEST PASSAGES

Economically, the geography of the Pacific makes future maritime shipping southward from the Bering Strait a matter of immediate choice between a course for North America and East Asia, both far below. Container shipping is almost certainly not in its future, and in any case not until late in the next century, for different reasons on the Northwest and Northeast Passages. The latter we will return to in context of discussion of that passage.

The value of the Northwest Passages differ on the Pacific from the Atlantic. Partly this is so because the long Baffin Island blocks easy commercial transit access from the Pacific into Hudson Bay. On the other hand, in warm world, the Labrador Sea-Hudson Strait gives easy access from the North Atlantic to Hudson Bay, opening up Western Canada exports, both bulks and containers to Europe

and elsewhere to the east without having to use the Saint Lawrence seaway. For export to Europe and eastward, a future, warmer Hudson Bay port presents a compelling competitive case compared with the Saint Lawrence Seaway and rail east to the Maritimes or south to the Gulf Coast. The areas of production are in the immediate geographic environs. Short runs of high quality rail and an expansion of Churchill is all that is required to make a world class Canadian export center.

Further north, as the melt continues, whatever is mined in Nunavut will go east and west by the passages. Transport to and from Asia via the passage is far more problematic. Container traffic in manufactured goods makes more sense riding the robust transmodal rail and port system to British Columbia or Seattle-Tacoma, which is newest, most modern, and most efficient of the major systems on the continent. It is difficult to find a financial case for Ontario or Quebec to export northward and then westward to Asia.

A container ship from East Asia bound for the Americas will proceed the North and South American ports and the Panama Canal, since Northwest Passage, far longer than Trans-Pacific route, cannot cross except through Parry Channel to get into the interior of the continent. There is no economic reason to build a container port on Canada's western Arctic: British Columbia already possesses some of the best ports in the Pacific and it is connected well to consumers, who don't live in Northern Canada. What may make sense, is a Canadian Western Arctic port for bulk shipment, dry and liquid, to the Far East, which likely will prove cheaper than rail transshipment from the prairie provinces to British Columbia. Here a MacKenzie Delta-Amundsen Gulf port may be competitive. Government funding for such a port would be frowned upon by Canada's railroad industry and British Columbia shipping interests, setting the stage for a political fist-fight. Foreign investment, however, in such a port, especially from China to bolster its \$30 billion investment in the prairie, on the other hand, is likely to be welcomed. Neither railroads nor the British Columbia shipping interests are likely to fight with China, which from a variety of cargoes imported and exported, puts food on their plate. The Canadian government is likely to have soft landing, if it can develop its Arctic with Renminbi, and if developed with the US, so much the better.

All this reinforces the point we made at the outset: *the value of Northwest Passages is less in full transit, than in specific routes between specific destinations. It is the same in routes all over the world today. There is no trans-equatorial route, but there are rather world lines of communications that connect great import and export regions.*

Chapter 5

Conclusions

We have only to look at the past 25 years to see how quickly change now occurs and how different the world can become. Population growth and urbanization, severe environmental decline with all its implications for food, water, and the climate, the continued synergy of technology and society can only bring greater change, for better and for worse. Another 25 years is a sufficient period of time to bring dramatic change to the world economy and how it works. Certainly we must expect that what is shipped will be different from today. As we have seen, the heaviest cargos on the seas today are iron ores and coking coal. A successful substitute for steel, whether from new materials altogether or from substantial improvement in the existing process of making it, would transform dry-bulk shipping. That every reputable climactic model extant today points to drought and famine, along with the increased development of genetically modified seed, and the patented monopolies it creates, portends shifts in agricultural imports and exports. What new inventions lead to what new products literally is limited only by our collective imagination, and there will be 2 billion more imaginations.

For all of these reasons and more, we should therefore not expect that world trade in 25 years will look as it did in 2008, especially given the long and difficult recovery that continues in much of the world as we write this today in early 2015. Globalization has always been an economic exaggeration in theory, and politically and socially an illusion. In practice, it is the result of consumer products built by cheap labor and, in the end, is enabled in very large part by the sudden rise of China into the world economy.

In hindsight, the type of globalization we ascribe to last 25 years has more the look at an anomaly than an enduring world construct. It was created by sudden emergence of information and communications networking, the most disruptive in human history, on world society, just as the moment when both elements of the old regime of the Cold War were exhausted. Communism had held most of the people in the world in isolation since 1945 and nearly all of the landmass of

Eurasia. In the developed countries, profits had been declining since the 1960s, and middle class consumers were overtaxed and saturated with stereos, televisions, appliances and cars. Taxes and recessions ate away at both ends. By 1990, the economic engines of the world, transnational corporations, had slipped the bonds of nation states, and created new mercantile economies through foreign direct investment in the undeveloped world. As a practical matter, that meant bargain basement labor and commodities without taxes and regulation. Economic statistics still miss this phenomenon. Inside the import-export data in the US, as much as 40 percent of the US imports are intra-firm transactions involving parts and goods purchased by the US subsidiaries of multinational firms or from foreign subsidiaries of the US corporations. Much of the exports listed from those nations with the largest ports — Netherlands, Belgium, and Singapore are all examples — are really goods in transit.

We are now through that adolescent stage of world re-order, seemingly wandering about awaiting what comes next. Two hundred million Chinese have been lifted from abysmal poverty, but they are now addicted to that betterment, and in the process, the world has become addicted to selling to them. Nationalism hangs stubbornly on, despite the erosion of diplomatic, economic and military instruments of power that created them four hundred years ago. The world economy may have become interconnected, but the world's peoples are deeply entrenched in their local identities.

From the old Cold War landscape, now the world has drifted across the past 25 years like so many ancient continents in the geologic past, and reassembled, into three great economic regions — North America, Europe and East Asia. Each has a vastly different social, political and economic character, growing more distinctly different with the assumption of the new Millennial Generation into the fabric of each. All have different dilemmas.

The US cannot get along with Central and South America, with which a new hemispherical and largely self-sustaining region could be built, nor can it exorcise itself from Europe and Middle East or wean itself from stupendous defense bills.

Europe cannot find a working political synthesis to match its economic cohesion, and addicted to exports, it is also addicted to imports. Finland exports what Russia sends it to Sweden. Deutsche Bank and BASF have addicted Germany to Russian gas, and Europe — save Great Britain and Norway — must do what Germany says. Europe must have globalized trade, yet it has no unifying internal transport infrastructure and can reach out only by sea, just as its maritime infrastructure has eroded.

China has created an internal monster and stoked a largely industrial age economic furnace beyond the temperature and pressure it can sustain, yet billions now are addicted to a better life. Its leaders seem to see only one way out, which

is to change its thousands of years of inward focus, and in modern remix set out into the world as a great mercantile empire. In our scenario exercise, a map of the British Empire compared to the geography of China's foreign economic investment has a remarkably similar contour around the world. Geography matters.

To the degree that the future will be an open world requiring intercontinental trade, transport is less an enabler than a limiter. Regions with great connectivity flourish; those with less struggle; and those with none will starve.

Future trade will depend on the transport options available at the time. Transport infrastructure is one of the last determiners in our world that is not a virtual enterprise, which makes it very different from most of the other underpinnings of the future. What cannot be exchanged virtually must move physically, which takes time, investment, and insight.

World trade does not happen at sea. It happens via the sea, and then only when it is cost-effective to do so. The construction of great ships takes a few years, but from the water's edge — to the source of commodities and the consumers of goods, construction takes decades. A choice to construct new trade lanes involves risk, and so does a choice not to construct them.

Thus, while predicting the future is folly, planning for it is obligatory. In the case of transport, there are definitive horizons beyond which opportunity will be lost. Ports that are not in construction today will not trade in 10 years. Where railway and road does not exist, neither will trade in 25 years. It is therefore possible to predict the future of transportation across much longer planning horizon and with much less risk than the future commodities and goods that will be transported. From the pages of a good atlas, one can see with considerable clarity two especially disruptive anomalies that are emerging today and will be in full evidence by 2040:

1. One of these is near total lack of transport in Eurasia regionally and across the continent between Europe and Asia, which renders the largest landmass of the world a transportation desert. Even Africa, beset by every tragedy known to humankind, though devoid of road and rail, has long navigable rivers and an array of ports of various capability. Commercial maritime transport in Eurasia today outside of the East Asia and the Indian Ocean is virtually zero. Roads are abysmal throughout, and Russia, the best of a poor lot and its propaganda notwithstanding, fits in this category. Its much vaunted "aid convoy" of trucks to Eastern Ukraine in September 2014, apart from all preparations and stops, took six days to travel 960 kilometers on one its few good roads. In Western Europe, Canada or the US, the same drive by equivalent military truck at posted speed limits would take 8 to 10 hours, and multiple routes.

The world at large pays a very great price for this. Women and children pay an even greater price. It retards international trade, restricts the civilizing influences of law and order, limits social intercourse, and political growth,

promotes illicit trade in drugs and women and children, results in poverty and environmental damage in the attempts to rise above it.

Beyond the patched and antiquated Russian Trans-Siberian rail routes: old Soviet rail that didn't get patched up, by and large, though Chinese efforts in Kazakhstan are slowly improving speed if not bureaucratic delay. That the Trans-Siberian lies wholly in Russian territory and that it is the only viable land route between Europe and Asia is a strategic catastrophe waiting to explode. DB Schenker and Deutsche Bank's efforts in the 2000s to use the Trans-Siberian to promote a Trans-Eurasian rail service direct to Duisburg not only had abysmal results, the effort works against the EU's interests at large. Rail to Duisburg, absent larger network in the EU, was to zip right past Eastern Europe, under Finland, for the export of German products and the import of cheaper East Asian goods, profiting only Germany while the EU's internal transport plans go largely unfunded.

Time and circumstance press China, Europe and Russia in this, for varying and different reasons.

2. The other great disruption is the opening of the Arctic and the many implications it brings along, beyond guessing at the time frame for melting or comparing the two passages, which are greatly different and are not likely to be in competition for anything.

Most of the discussion today about the opening of Arctic Ocean passageways is rooted in the context of present transport. Within a minute or two of surfing the Internet, the conventional perspective emerges in which transit to and from Europe to the Pacific is shortened by thousands of kilometers. Within a few mouse clicks of that, discussions emerge about which passage will open up first, which will be more important and so on. We think these initial perspectives will give way quickly in the next decade as the world becomes more accustomed both to the emergent geography and the new economic possibilities it presents.

Not since the fifteenth century has the world suddenly been opened to such vast new and largely unexplored spaces and the riches they contain. It is inevitable that Arctic opening will cause great economic and political disruption, especially from large new sources of commodities coming onto the world market relatively suddenly, as was the case with gold, silver, sugar and cotton after the discovery of Americas. Indeed, at this early stage of excitement (if one can use the term about the melting of the ice caps) nearly all of the European and Asian focus is on commodities, in the form of oil and gas exploration, production, shipment, which may come just in time to save Russia from going down for the third time in less than

100 years. Over the next 25 years, additional commodity discoveries will emerge, and we may reasonably expect a continuation of the past decade in which governments vie with major transnational corporations for lucrative contracts to exploit them. There is already sufficient exploratory engineering to be certain that the Arctic contains enough oil to threaten Saudi Arabia's ability to control prices by controlling production volume. We can be assured that the kingdom, which possesses the largest sovereign wealth the world has ever known and one of the world's best intelligence agencies, is acting in the present to prevent that future.

As melting proceeds by mid-century, Antarctica too will melt at rates and with consequences that are little more than a wild guess for science today. With each year that passes, as the Arctic opens and Antarctica melts, our knowledge and experience will deepen. Antarctica's resources will become understood, and they are likely to be formidable. Excluding its ice shelves, it covers over 13 million square kilometers compared with 7,7 million square kilometers for Australia, or 10,5 million square kilometers for Europe. The rocks of the East Antarctica shield are as old as 4 billion years, which means that they are amongst the oldest known rocks on Earth. Exploration for minerals and petroleum basins is still very rudimentary, and much controversy has arisen about just what the southern continent might contain. It is clear, however, that some of the most important commodity finds today in South Africa, Australia, and South America were connected with Antarctica as part of large ancient continent of Gondwana. If Antarctica were to come up empty of commodities, it would be the only continent that did.

From the vantage point of 2015, it seems a remarkable thing that a generation ago, trade was only then emerging slowly expanding outside the North Atlantic sea-lanes — an area of about 45 degrees of northern latitude and 115 degrees of longitude. In 2040, it will no doubt seem a wonder that the economic and political world of our time had spread across longitude, but still only about half of the latitude of the planet. For most human beings alive today, the geography and geology of the poles may as well be that of Mars. That will not be so in 2040.

We have provided the passages in detail in the previous chapter, but our focus is on the larger implications of new regional geography and the potential for displacement and realignment of the present economic region into a different and fundamentally new global geography.

RUSSIA'S DILEMMA

Winston Churchill once stated across the radio, "I cannot forecast you the action of Russia. It is a riddle, wrapped in a mystery, inside an enigma." With the hindsight of seven decades, nothing could be further from the truth than Churchill's observation.

Russia's dilemmas are crystal clear, from the Romanovs through the Soviets and now to Vladimir Putin. It cannot bring a visionary, much less free, government into being for the benefit of the Russian people. It cannot build a flexible, broad-based economy. It cannot develop modern infrastructure. Any cloak of mystery that once baffled Churchill has long grown transparent and threadbare.

Western Europe, Japan, Singapore, South Korea and China all were destroyed during the Second World War. All then rebuilt to sophisticated and diverse economies. All used the period of globalization to grow strong, and their people prospered. Russia has slipped backwards, deeper into a quagmire of corruption and the cynicism it engenders. Perhaps worst of all for Russia's people, it is a society that has squandered the opportunities to modernize that were presented from the now-distant beginnings of the industrial age to the present. Now, as the pace of change in the world seems endlessly to accelerate, the speed with which Russia is left behind is accelerating with it.

China suffered extraordinary calamities for a century before the decrepit Qing dynasty finally fell, and in the twentieth century, all the terrible apocalypses — conquest, war, famine, and death — were visited on the Chinese people — all with appalling consequences. Famine alone in 1907, 1932 and again in 1961 took 60 million lives.

Yet China, though unquestionably weighted down with many difficult problems, certainly is no longer a backward country. Six hundred million Chinese have been lifted out of poverty in the past twenty-five years. Possessed of no modern factories, no exports, no energy save coal, few raw materials, few skilled workers, no internal transport infrastructure, antiquated information infrastructure, neither merchant ships nor modern ports or facilities, without allies, saddled with committee rule and above all, with 1.3 billion mouths to feed, China's success is an unparalleled achievement in world history. Five of the world's ten largest and most valuable companies are Chinese. Never have so many come so far in peace or war.

Russia instead, has two major cities, St Petersburg and Moscow. Novosibirsk, Yekaterinburg, Nizhny Novogorod (former Gorky), Samara, Omsk, Kazan, Chelyabinsk, Rostov-on-Don, Ufa and Volgograd — Russia's other cities above 1 million on population — are largely isolated in global terms. Moscow itself is larger than the populations of all of these combined. In 2013, Russia could muster four companies in the top 100 worldwide, and all them are the Russian oil and

gas companies, save Sberbank, which is owned by the Russian state central bank.

It did not have to be so. Possessed all of the things China lacked, including of some great amounts, Russia had only 130 million people, nearly all of them in concentrated in ten urban areas and educated. Far behind the West, and now the East as well, in technology, engineering, and manufacturing, Russia nonetheless once possessed an excellent scientific base from which to build. Moreover, in 1990, finally free of both the Tsar and of Communism, the new Russia no longer had intransigent enemies in the West. Instead celebrations were held, and Western funding from commercial and investment banks, from large international corporations, and from the IMF flooded in. A Lee Kuan Yew, Deng Xiaoping, Nelson Mandela, Aung San Suu Kyi or Joko Widodo might have made a country out of it.

Certainly they would have envied the economic grist to do so that Russia has resident it is energy. Yet, possessed of some of the largest energy reserves in the world and despite 140 years of experience in energy development, today, Russia cannot prepare the fields, bring either gas or oil out of the ground, or build the pipelines, pumps and machinery necessary to bring it to market without Western industry and foreign capital to do it for them. Nor can its decrepit refineries produce volumes of export grade product from it. Nor can its tiny tanker force on the Black Sea and its two tiny seaports, Murmansk and Vladivostok, provide the kernel to grow a great tanker presence in the world.

Dispossessed of previously conquered republics, Russia now possesses common language, a common culture, a common history, and, above all a common experience of suffering, post-USSR Russia will have to be able to elect successive and responsible government, and sustain a grassroots movement for alternative and better government.

What China has had is brilliant leadership, starting in 1978 when Deng Xiaoping effectively took over its reins. It has managed the privatization of China's major industry carefully, across nearly three decades. Moreover, China's leaders, while certainly taking care to enfranchise themselves to be sure, have worked for the betterment of the country.

EUROPE'S DILEMMA

If all of this affected only Russia and its people, it would be tragedy far less concerning to the outside world. Decidedly, however, this is not the case. Russia's dilemmas cause in turn a set of serious dilemmas for Europe, for China, for the Central Asian republics, and, in particular, for NATO. An isolated entrenched

Russia can only decelerate globalization, which is already at a crossroads after the 2008 crisis.

Russia's geography places it astride three of the world's most vital lines of communications: the Northeast Passage across the Arctic, the only viable Trans-Eurasian railway, and the developing Eurasian energy pipeline system. Twenty-five years ago, none of these would have mattered. Now, however, the Far East is a vast import and export region that Europe cannot do without. Twenty-five years from now, when more than 9 billion are on the planet and urbanization recreates the landscape of the Indian and Pacific Oceans, the necessity for those regions to trade with Europe and America, whether for markets or raw materials, will diminish. The more difficult and dangerous the communications lanes between Europe and East Asia are, the greater risk to profit and the less propensity to trade.

If Trans-Eurasian routes are developed as robust, modern and international in character, they can emerge as the keys to a future open, connected and prosperous Europe and Asia. They will act to deepen linkages and open commerce. On the other hand, if they are not built, to whatever degree the Far East and Indian Ocean economies gravitate into intra-regional trade, Europe will become increasingly isolated, dependent on a presently declining maritime shipping infrastructure. Similarly, if Trans-Eurasian routes are allowed to be dominated or monopolized by any single nation—much less a chaotic, corrupt and autocratic state as Russia has become—Europe's only option beyond shipping closes.

Trade among East Asia and the Americas acts to increase this disadvantage. The Pacific facilitates those trading routes, as we observed at the close of the previous chapter. North America, in particular, and the Eastern Pacific are well-connected. The Panama Canal opens the Caribbean Sea, and facilitates new transport hubs there and along the northern rim of South America. Atlantic Europe — the United Kingdom, Norway, Denmark, Iceland, perhaps Spain, Portugal and France as well — is all brought closer to North America by the Arctic melting. It is continental Europe that is odd-man out.

From the standpoint of grand strategy, then, at all costs Eurasia must become a conduit to facilitate the movement of ideas and commerce. The geography of Eurasia dictates only a few alternate passages to crossing Russian sovereign territory. Therefore, *an isolated Russia isolates the largest trading blocks in the world. Russia is too large and possessed of too many important resources to allow all it to fester and fail, or to descend into a difficult and dangerous pariah, or worst of, into chaos.* This is the danger behind Russia's chronic failure to develop.

Because the opening of these passages will take decades of development, no matter how the immediate crisis begun in 2014 ultimately plays out, Russia will continue present a series of difficult and long-term dilemmas, to its people, to Eurasia from the Atlantic to the Pacific, and to a lesser degree, to the rest of the world well into the mid-century. Any pretense that Russia is a viable stable and

predictable nation state at present has been erased from even the most gullible observers. Despite repeated opportunity and large inflows of foreign investment into the country, in the past 25 years Russia has not been able to elect a responsible and responsive government. Russia must be brought at last into the modern world order and develop into a more stable, predictable, and successful nation.

It is not enough that Russia's economy prospers through the sale of commodities. Great wealth has been derived from the sale of energy in Russia since the 1970s. The Soviets used it on grain imports because of chronic agricultural failures and diverted much more into its military-industrial complex. Putin has awarded it to his cronies to maintain office, and nearly all of it is now closeted outside of the country. So long as Russia can get by exporting raw materials, her internal infrastructure will not be developed nor will wealth be distributed and leveraged. That is the lesson of the last 100 years.

Nor is it enough that Russia's government merely be stabilized. A bad government stabilized, which is a possible outcome of the present crisis, helps no one but those in it. All wealth and energy is driven into self-sustaining activity, which, of course, has been the problem not only in Russia, but also in Central Asia at large, and in much of the undeveloped world. A way must be found for Russia must prosper from industry and economy derived within her borders so that infrastructure can be modernized, and opportunity realized to foster and sustain community. Talent and leadership must arise. Only then will the passages across Eurasia be opened and a conduit for progress created.

There are additional dangers internal to the EU. As we observed in previous chapters, *today Europe's hinterland freight transport is limited both in size and in direction. To the degree that Germany (or German banks and companies) come to dominate the landward routes to the Far East, which has been the past and present trend, it will also dominate the trade. As the EU works its way through the its various crises in the future, a map of European land transport should never be too far from hand. Germany is the economic core of the EU, and so long as linkages like DB Schenker's Trans-Eurasian rail to Duisburg and pipeline projects like Nord Stream are allowed to dominate the pattern of Europe's spatial economic topography, the rest of Europe will be cut off. Absent development of a modern, networked land transport infrastructure that connects Europe at large, particularly in the north-south direction, large areas of the EU will languish, intensifying the political, social and economic challenges of unity.*

Beyond trade and transport, there is also a price to pay for security, which after the 2014 Ukraine crisis, can no longer be ignored. One way or the other, the EU will have to expand politically if it is to expand economically. The past 25 years of business and globalization jargon has blinded both the voters and the politicians of the West to the enduring geography of grand strategy. The US will pay a very heavy price one day for allowing Latin America to fall into corruption, and the EU, as it now sees, has paid a very heavy price for ignoring its eastern perimeters.

Geography matters: every border of every country is a potential friend and foe.

Had Germany championed Ukraine's entry into the EU, Europe's borders would have been secured, as well as access to the Caspian Sea and beyond. Had an E-75 corridor been pushed through, Eastern Europe would no longer be isolated. Access to the oil and gas of the Middle East, Iran, North Africa, Azerbaijan, Georgia, Kazakstan, Turkmenistan, and Uzbekistan would have been certain. So, too, would have been the only other possible land route to the Far East that doesn't cross Russian territory. The Turkish Straits would have been an open gateway instead of a chokepoint for the first time since the ancient Greeks. Admission of one country, Ukraine, despite its corruption and backwardness, would have been cheap at the price to modernize.

Angela Merkel's Minsk settlement, which collapsed shortly afterward, would have been fatal, leaving Ukraine divided as Germany once was and cementing in place security for Russia that the EU might have had instead. Now it is impossible to admit Ukraine into the EU or NATO. Above all, it gave Vladimir Putin the political win he sought to solidify his hold on Russia, where patriotism is the last refuge of scoundrels and the Russian people's capacity for sacrifice for Mother Russia is boundless. Offering peace to a man that needs war is never successful.

Yet it did not have to be done. As Putin by now has clearly come to understand from his generals, he also has no real military option. A push as far the Dneiper would divide Ukraine in two, scare Belarus to death and give the rest of Eastern Europe palpitations. But it would also leave its troops exposed on the Northern Highlands of Ukraine, limited in the north by the Pripet Marshes and in the south by the Black Sea. Certainly even with Ukraine's disheveled military, such an advance would not be sustainable without massive air cover, which Russia no longer possesses. What it can muster would be shattered within days if the EU and NATO intervened and without invading its air space.

Nor could Russia support such an invasion. The military maxim of interior lines belongs to the last century, and in any case, in Russia, roads are abysmal throughout. Even the best roads of a poor lot, its propaganda notwithstanding, fits in this category. Russia's much vaunted "aid convoy" of trucks to Eastern Ukraine in September 2014, apart from all preparations and stops, took six days to travel 960 kilometers on one its few good roads. In Western Europe, Canada or the US, the same drive by equivalent military truck at posted speed limits would take 8-10 hours and multiple routes.

At the same time, the geographic distances that once safeguarded Russia from invasions by Napoleon and Hitler have long been reduced to zero by modern weaponry. Nor would an invasion be necessary: what infrastructure Russia has in the south to support a military action — oil and gas pipelines, roads, airfields, power plants, ports and more — would be gone in hours from missile strikes long before Putin had a chance to protest. Moreover, without Georgia and the Central

Asian republics, the entire Russian underbelly would be exposed, especially the troops forward in Ukraine.

Putin knows this well, but after Merkel's mission, he also knows he can keep Eastern Ukraine without military response, albeit with dreadful economic consequences. And yet, it may come to that. Armed conflict is the one thing that might galvanize the Russian voter, who like voters the world over will swoon at the thought of national troops under attack, whatever the reason. Calculating in his ever-tighter corner under sanctions and faced with personal political destruction, this cannot be lost on Putin, whose playbook thus far has been right out of history books. Still, Vietnam and Afghanistan toppled governments for the same reason: there are limits to how many coffins can come home.

The EU/US sanctions are pressing Vladimir Putin into a dangerously tight corner, from which perspective all observers can now see that the issue at hand is less the Ukraine than Putin himself. His ability to remain in office is now in jeopardy. Serious enough to risk the murder of Boris Nemtsov, which could not send a clearer picture to the world and the Russian people. The outcry in Russia, however, was muted. The funerals of rock stars and targets of the paparazzi have had more flowers and a bigger turnout than that of Boris Nemtsov. A telling commentary of the situation was the reply a relatively low level police officer to a reporter's question about suspects. There are always suspects, he said.

THE VALUE OF UKRAINE

Unlike Russia, Ukraine did not have commodity wealth that had intrinsic value to attract businesses with relatively low risk and short-term gain. Investing in Ukraine was clearly not a good opportunity on the world stage, and still isn't. To a business, it made perfect sense, therefore, to avoid investment in Ukraine.

From a government perspective, however, Ukraine posed the first opportunity in several hundred years to extend Europe culturally, economically, and strategically. It would not only secure Europe's southeastern flank, it would give the EU access to Central Asia, exposing those nations, if only very gradually, to law and order. Transport routes would become available, as would access to energy from Central Asia and, more importantly, from Iran.

There would also be long-term alternatives to Russia's monopoly on Eurasia, which the Chinese investment in the Silk Road routes clearly demonstrates. That China bought into Russia's pipelines and energy supplies in 2014 should be seen as opportunistic, not strategic, move. It offered the multiple advantages of securing additional long-term supplies of pipeline gas for its industrial changeover from

coal, of denying those same assets to Japan and South Korea, all the while addicting Russia to China. Strategically, China faces three imperatives:

1. It must find away to undermine its Asian competitors. Soon China will not be able to undercut the Asian labor market prices any longer, but neither it competes in quality for a very long time yet. Therefore, if it cannot take market share from South Korea and Japan, the remaining viable grand strategy it to increase their costs, and if possible, reduce their output, both of which can be greatly facilitated by denying ready access to commodities. Buying up Russian pipelined gas and oil plays right into that strategy.
2. China believes it must push the US out of the Western Pacific. Their strategy for this is exactly the strategy the US employed against Soviet Union: it will force the US into an arms race, which the US defense industry and military readily welcome, having expended much of its material in the past 20 years in Middle East conflicts. China's naval buildup in recent years has alarmed the powerful navy-dominated US Pacific Command, while at the same time Japan has foolishly forced the US out of Okinawa. The US can only retrench to Guam, building that island into a fortress at immense cost, miles farther east from China.
3. China must find a way out of the geography constraints imposed by the Straits of Molucca. The long-term solution is through to Central Asia via Xinjiang, which gives them that access and the energy and mineral commodities there to boot. Given the long view, at which China excels, investment in the Trans-Siberian rail and routes is counter-productive. It is instructive to view China's investment in that light.

Ukraine's value to the EU is not a mirror image of Ukraine's value to Russia. To the contrary, they are opposite. Whereas the Soviet Union and the Romanovs valued Ukraine as a buffer against the outside, the EU may value Ukraine as an extension of its security, transport base, and energy resources. The price is to support and modernize its economy, just as it must do, however begrudgingly, in Greece.

DRAGONS BE THERE

Russia's dilemma has not come out of the blue. In practice, a strategy of dragging Russia into a larger world, instead of containing it in place, will present an extraordinary conundrum of truly global proportions. In the past, the US and Saudi Arabia have been able to constrain Russia by manipulating oil prices and supplies. This has been a lynchpin of the US foreign policy since the 1980s and of Saudi policy since the 1950s. Russia's vulnerability to this stratagem has been its long-term failure to create a manufacturing economy. Today, a key factor in Russia's risk is that crude and refined oil exports generate four times the revenue of gas exports, and crude alone accounts for more than all gas and non-oil exports together.

Briefly, Russia's dilemma is its addiction to oil and gas. So long as it can produce nothing of value to export beyond oil and gas, and cannot elect a government able to expand and modernize the economy, its addiction increases against a diminishing supply, deepening the risk of collapse in an ever-narrowing vicious cycle.

Time is also an issue here. Russia's foreign currency reserves, built up so rapidly during the 2000s when oil prices were extraordinarily high, are being depleted at an alarming rate. Its ability to borrow at reasonable credit rates is limited by its past history and by the estimates of the mid-term, not the long-term, future value of its oil fields, which are by far the largest generator of hard currency. Selling more gas to Asia will not resolve Russia's dilemma, which is at present about oil revenues. The world is awash in energy, and it is clear that other forms of energy, such as oil shale and oil sands, will become available to the world when the prices begin to rise. Russian Arctic energy, which is largely natural gas, is going to take a decade or more of high investment in an extreme environment. Only three sources of funds in the world are large enough to bankroll the Arctic effort — a Western supermajor consortium, a Middle Eastern sovereign fund, and potentially China, which would have to tie up a great deal of capital for a very long time to do so.

Europe, then, having deliberately addicted itself to Russian energy, having refused investment in defense, having lost its shipping and manufacturing to the Far East, and unwilling to extend its economic alliance to Ukraine and unable to solidify it politically, stands at a very late hour into danger. Until the tracts between Western Europe and the Western Pacific are uncivilized and its people lacking in good government and economic promise, dragons be there.

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MICHAEL LOESCHER and **MIKA AALTONEN** believe that "opportunity is found through thorough analysis, and that most organizations resist change because, lacking clear data, the internal and national discussions are loaded with rhetoric and opinion."

CROSSROADS – Transformations on the Road to 2040 speaks to a single fundamental question: "Can we survive the next 25 years with the present economic, diplomatic and national security policy underpinnings?"

We have several objectives in mind:

- To conduct a dialogue across agencies, public and private, to leverage talent, organization, and money.
- To recognize that national economy and national security are linked.
- To introduce a structured, dynamic, and analytic rigor moving past studies and arbitrary scenarios.

There are number of themes by which the next 25 years can be explored, but the most encompassing is the transformation in global transportation. That will bring the world to us, it will bring great risk and great opportunity, whether we like it or not.

CROSSROADS – Transformations on the Road to 2040 discusses how Finland can emerge further from its borders, out into the world at large. It provides a basis to answer several enduring problems, such as, how to expand the economic base, how to extend partners beyond the EU, and how to defend the nation, given its geographic confines.



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