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Same moon rising: On the non-existence of a unique Japanese model for supply network dynamics

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ABSTRACT
The industrial organisation of Japanese industry in keiretsu-type of supply networks has long been considered a phenomenon attributable to cultural factors, as something uniquely "Japanese". This paper challenges this view, both theoretically and empirically, Theoretically, the paper draws on the field of operations management, first by making the comparison with "lean production" and secondly by providing alternative explanations for the specific structure of Japanese supply networks such as modularity of product architecture, industry clockspeed and industry maturity. Empirically, the paper provides illustrative case examples of very different supply network structures in different Japanese industries, varying from clockspeed aerospace via medium to high clockspeed electronics and telecom, which show how industry settings, and not culture, determine supply network structure and dynamics.

Ame no hara	When I gaze far out
furisake mireba	Across the plain of heaven
Kasuga naru	Isn't that the same moon
Mikasa no yama ni	That rose up over the hill
ideshi tsuki kamo	Of Mikasa at Kasuga?

Abe no Nakamaro*

Introduction: the enigma of Japanese supply networks

Cultural explanations for economic differences in what one observes in different countries have long been notoriously popular, certainly in the case Japan. In the 1980s, several of Japan's export industries were surprisingly successful, most notably its automotive and electronics firms. This success was surprising, but also hard to explain. Marco-economic considerations such as labour cost differences or currency exchange rates seemed inadequate to account for Japan's achievements. In its business organisation, Japanese firms were especially enigmatic. In its internal operations, Japan did not rely on high levels of fixed capital, or on extensive IT systems for goods flow control. Japanese companies such as Toyota had developed a completely different production system, focused on reduction of waste and complexity in every aspect of the business. Initially, many U.S. and European business researchers ascribed this production system to Japanese cultural

* by the Japanese poet *Abe no Nakamaro* (698-770), allegedly composed shortly before starting the return journey from China to his home region (McCullough 1985).

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characteristics. They emphasised Japan's traditional focus on quality, on craftsmanship, on cleanliness, on simplicity. From tea ceremonies to Zen gardens (e.g. Pascale 1981) were used to illustrate the assumedly fundamental "Japaneseness" (Gordon 1998, Donahue 2002) of Japanese factory operations.

Nowadays, this approach to internal organisation of manufacturing operations is commonly referred to as "lean" (Womack and Jones 1990). It is practiced with great success by thousands of organisations in a variety of industries in the U.S. and Europe. Toyota is still a role model here, and is still presented as "the world's greatest manufacturer" (Liker 2004), but there is no longer talk of a unique Japanese approach to manufacturing: lean is "just" a superior approach to manufacturing in any country the moon shines upon.

Similarly, Japanese supply networks have long been an enigma to western researchers. Back in the 1980s, most U.S. and European manufacturing firms were vertically integrated, with all production operations under unified ownership. What needed to be bought was procured from suppliers who were constantly evaluated against their price and performance, and with whom relations were kept at arms length. In Japan, the situation appeared to be totally different. The bulk of production was outsourced to a large group of suppliers. Relations with these suppliers appeared to be close and hierarchical at the same time. The lead firm was clearly the leader of the pack, and yet there were no clear majority shareholding positions with the firms forming the supply base. The term *keiretsu* for this kind of "vertical supply pyramid" (Paprzycki 2005) became known in the West, but how it could exist and be so successful remained an enigma.

Again, explanations for how this model had come about initially focused on Japanese culture and history. The long history of the precursors of these *keiretsu*, the so-called *zaibatsu* that were formed during the Meiji-era (1868-1912), was stressed. Moreover, researchers stressed the focus of Japanese culture on group performance and on collaborating in teams, the prevalence of moral obligation concepts such as *giri* and *ongi*, the long-term existence of informal behind-the-scenes negotiations called *nemawashi*.

Surely, these cultural practices exist and historical path dependencies are apparent. But are these sufficient to explain the prevalence of Japanese *keiretsu*-like supply networks? Interestingly, cultural explanations for the enigma of these supply networks appear to have persisted until recently, both in the business press[1] and in academia (Fruin 1997, Laage-Hellman 1997, Robertson 1999). It has not been since the last five years that this highly questionable fundamental premise, that Japan's society is fundamentally different and that this explains why Japanese firms behave the way they do, has been seriously debunked. In 2006, researcher Miwa and Ramseyer effectively tore the whole empirical notion of keiretsu, and even of their predecessors, the *zaibatsu*, to shreds. In their view, *keiretsu* have only existed in academic papers and the business press, never in the real world, and they present an overwhelming amount of evidence for their position, even when their style may be somewhat partisan.

This paper takes a different position. It argues that in the field of Operations Management (OM), there is considerable evidence that the structure and behaviour of

[1] For example, in 1999 The Wall Street Journal, wrote "The tenets of the Japanese model, so lauded in the 1980s, are now widely discredited" (WSJ Nov 1, 1999 quoted in Lincoln and Gerlach 2004, p.297)

supply networks is strongly determined by three factors, none of them culturally dependent:

(1) the rate of innovation in an industry, also known as *industry clockspeed* (Fine 1998);
(2) the life cycle stage of an industry, also known as *industry maturity* (Abernathy & Utterback 1978).
(3) The product architecture, and the extent to which this is modular or integral (Baldwin & Clark 1999, Fine 2005).

This paper argues that Japanese supply networks dynamics are largely driven by these three factors, just the same as in the rest of the industrialised world, albeit with some time delay. Examples from both high-clockspeed and low-clockspeed industries are used to illustrate this point. It appears that we are all looking at the same moon, although it may appear different in different places.

The impact of industry clockspeed on supply network dynamics

The faster your environment changes, the more flexible a system has to be in order to to survive in that environment. This essentially biological concept, also known as Ashby's Law of Requisite Variety (Ashby 1964), has found fertile ground in the field of organisation and management. (c.f. Bourgeois & Eisenhardt 1988, Brown & Eisenhardt 1997). In the area of supply networks, it has been voiced most clearly by Professor Charles Fine of MIT, who coined the term "industry clockspeed". With "clockspeed" is not meant here the speed of the microprocessor in a computer, but the rate of change in both product innovation and process innovation in an industry (Fine 1998, 2000. Fine's hypothesis is that, as firms have to deal with greater intensity of innovation, they will organise their supply networks more flexible. Ever since its introduction in 1998, the clockspeed concept has been explored in a variety of industry settings and confirmed repeatedly (c.f. Mendelsson & Pillai 1999, Nadkarni & Narayanan 2007).

	Product clockspeed	**Process clockspeed**	**Organizational clockspeed**
Fast-clockspeed	***industries***		
Personal computer	<6 months	2-4 years	2-4 years
Semiconductor	1-2 years	2-3 years	3-10 years
Movie industry	< 3 months	< 1 year	2-4 years
Athletic footwear	< 1 year	5-15 years	5-15 years
Toys & games	< 1year	5-15 years	5-15 years
Cosmetics	2-3 years	5-10 years	10-20 years
Slow-clockspeed	***industries***		
Aircraft	10-20 years	5-30 years	20-30 years
Tobacco	1-2 years	20-30 years	20-30 years
Steel	20-40 years	10-20 years	50-100 years
Shipbuilding	25-35 years	5-30 years	10-30 years
Petrochemicals	10-20 years	20-40 years	20-40 years
Paper	10-20 years	20-40 years	20-40 years
Diamond mining	>100 years	20-30 years	50-100 years

Table 1: Different kinds of clockspeed in different industries

Which kind of structure is more flexible? A network is more flexible than an integrated firm, because it is easier to exchange parts of a network than parts of an internal organization, and because networks can have more links to the outside world than an integrated firm has. So, one would expect more interorganisational networks in higher-clockspeed environments, and one would expect these to change more frequently over time as the clockspeed becomes higher. As Fine noted, some industries have by nature a slow clockspeed, others by nature a high clockspeed. The movie industry is a good example of high-clockspeed, as new movies are produced multiple times per year and last only a few months. The aerospace industry is an example of a slow-clockspeed industry, as an aircraft typically lasts 30-40 years and new aircraft types are lauched once or at the most twice per decade. Table 1 gives an spectrum of different kinds of clockspeed in different industries, to illustrate the diversity that exists within the same economy (based on Fine 1998 and Nadkarni & Narayanan 2007).

The impact of industry maturity on supply network dynamics

Another driver for supply network dynamics also has roots or parallels in biology. In 2000, palaeontologist Jay Gould published his delightful "Wonderful Life" (Gould 2000). In this book he describes what he calls "the Cambrian explosion", which took place some 550 million years ago. In this burst of anatomical exploration during the Cambrian era, a dozen fundamentally different phyla, or major body plans, emerged in the seas, and were found back in an extremely rich area of fossil deposits called the Burgess Shale. From this deposit, palaeontologists have deducted that, 550 million years ago, diversity of life on earth in terms of anatomical designs was much, much greater than it is today. Most of the basic anatomical designs found in the Burgess Shale do no longer exist, and all organisms today can be traced back to a minimal number of survivors. Apparently, progress in life consists of trying many, many different things first to find that only a few of those are successful and then subsequent evolution takes place on the basis of those few lucky winners. So, apparently, in biology, progress is not a matter of increasing diversity, but rather of drastic decimation and diversification (from Gould 2000, p. 46).

Abernathy and Utterback made fairly much the same argument earlier in 1978, probably completely ignorant of this paleontological parallel. They looked at industry life cycles and observed that, during the early stages of the life cycle of a technology uncertainty is high and all sort of innovations are carried out. It is capabilities in *product* innovation that then is most important. Gradually then, a small subgroup of "dominant designs" emerge as winners and, which reduces uncertainty. From there on, there is a shift from capabilities in product innovation to *process* innovation, to making the product as swiftly, cheaply and correctly as possible. In terms of supply network design, this may imply that during periods of great uncertainty, a high degree of integration can act as a constraint but later on, when process innovation is key, it may be an advantage (Paprzycki 2005 p.32, Nadkarni & Narayanan 2007).

The misleading example of the Toyota *keiretsu* supply network

Toyota may well be the best manufacturing company in the world, as some of its proponents suggest (Liker 2004). It certainly has become the biggest and most profitable firm in the automotive industry, still one of the largest industries around. And it does have remarkable practices in its operations management, human resource management, finance and strategy that can be of great value to many other organisations in other countries and industries.

However, all this success and prominence may be misleading for our current question, which is if hierarchical pyramid-like *keiretsu* networks are really the dominant life form in Japan, and uniquely so in Japan. This is, because, if anything, the Toyota keiretsu has become *more* closely integrated and hierarchical in recent years, not less (c.f. Ahmadjiam & Lincoln 2001). In the Abernathy and Utterback (1970) line of reasoning this makes good sense. In the automobile industry, which is a mature and medium-clockspeed part of the economy, process innovation is more important than product innovation. For successful process innovation, close alignment of all the stages in the production process with one another is key. And Toyota is certainly a world-class player in this area.

Fine makes essentially the same argument when he stresses in a recent article (Fine 2005) the need for close alignment of product and supply chain architecture. In an extended quote: "Toyota products epitomize integral architecture. The company's product development philosophy stresses the importance of cross-functional coordination for the development of most vehicle subsystems. Through close attention to the interplay among automotive sub-systems, Toyota has achieved highly responsive acceleration and braking; well-designed climate control, acoustics, and other driver comfort features; efficient use of space; and pleasing interiors. The architecture of Toyota's supply chain parallels its product architecture. Toyota has historically maintained extremely friendly ties with its suppliers, in some cases taking a financial stake in them. As part of this relationship, many of Toyota's key suppliers are situated near the automaker's engineering and development operations in Toyota City, midway between Tokyo and Osaka. And with this geographic, social, and cultural proximity among Toyota and its suppliers, there is continuous bidirectional feedback on vehicle and subsystem design. One important example of this cozy partnership: Toyota engineers spend a great deal of time working at supplier sites to ensure that subsystems and components deliver the high level of integrality that the Japanese automaker demands for its vehicles. Toyota's product and supply chain architectures are complementary and mutually reinforcing. The integral product architecture requires a tightly bound, integral supply chain, which, in turn, represents a significant factor in the ongoing development and production of Toyota's vehicles." (Fine 2005, p.5).

However, one would be making a fundamental mistake in logical reasoning if one would think: "Toyota is a major Japanese company, Toyota has a closely integrated hierarchical keiretsu supply network. Therefore, all Japanese companies have closely integrated networks". This logic is flawed. It is after all not the Japaneseness that counts, but the industry clockspeed and product architecture, and when these are different the supply network will be different.

Figure 1: Supplier relationship portfolios in Japan and the U.S. (Bensaou 1999)

One would even be making a mistake by thinking: "Toyota is a Japanese automotive company, Toyota has a close hierarchical supply network, therefore, all Japanese car makers must have close hierarchical networks". For different companies make different choices with regard to their product architecture and corresponding supply network architecture. To illustrate this, Figure 1 is revealing. It summarises findings from Ben Bensaou (1999), who looked at the portfolio of relationships that both Japanese and U.S. car makers managed, and found that (A) within the automotive sector, there are close and hands-off relationships, and B) the differences in the relative proportion of these is not at all so great between Japan and the U.S.. For instance, partnership relations were 25% of the Japanese sample and 19% of the US sample. On the other side of the spectrum, hands-off market-exchange type of relations were typical for 25% of the U.S. sample, but for even more of the Japanese sample, 31%.

The revealing example of electronics: impact of clockspeed on supply network dynamics

Taking a different industry may provide us with a different perspective. Why not look at the biggest industry in the world today, the electronics industry, that overtook this No. 1 position from automotive not so long ago. How close-knit, stable and hierarchical are relationships there?

As it turns out, it depends. What is the same throughout the Japanese electronics industry, is that the bulk of production has moved abroad, in particular to the other South-East Asian countries. Figure 2 shows the geographical distribution of supplies for a recorder head for a video recorder for Hitachi, as it was in 2000 (based on Paprzycki 2005). The legend reads like a list of AESAN countries, whereas 5-10 years before, most production took place within Japan. Outsourcing and global sourcing is definitely not a European or U.S. invention, and this applies to all of Japan's electronics industry.

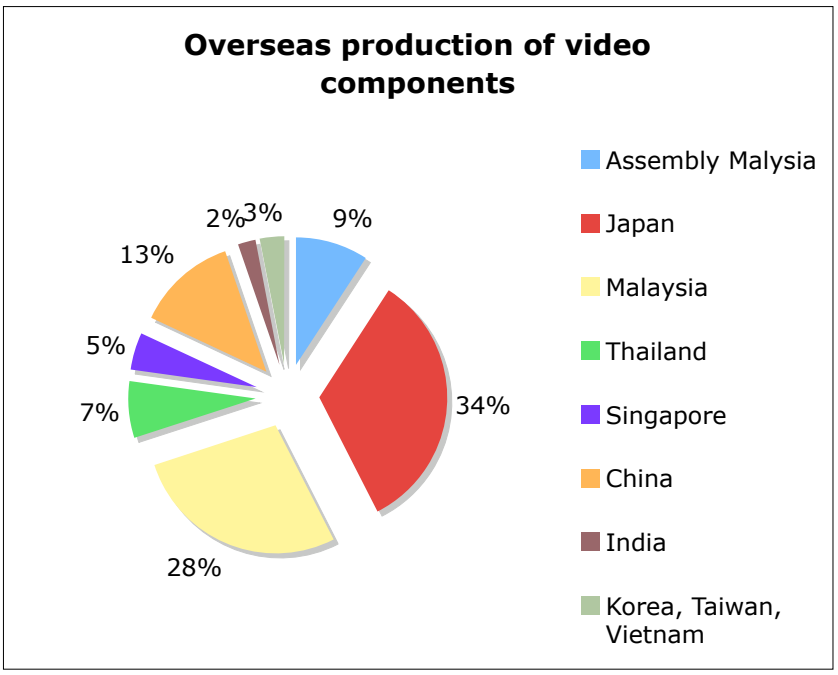

Figure 2: Geographical distribution of video components for Hitachi in 2000 (based on Paprzycki 2005)

However, what is *not* the same throughout the electronics industry, is the degree in which these Asia-based supply networks consists of new and non-Japanese companies, and the degree in which there is hierarchical co-ordination rather than collaboration among equals. In electronics, video recorders are an old technology, that has been around for over twenty years. So, relatively speaking, for electronics this is a low-clockspeed industry, where seamless and low-cost processes are of the essence. Therefore, what we see in this video network is basically the same Japanese suppliers that Hitachi had ten years ago, but now in their transplanted operations in Asia. This is still a fairly closed, vertical *keiretsu*-type of supply network.

If we move to a relatively more medium-clockspeed environment in electronics, such as the computer PC industry, we see a different picture, as becomes apparent from Figure 3.

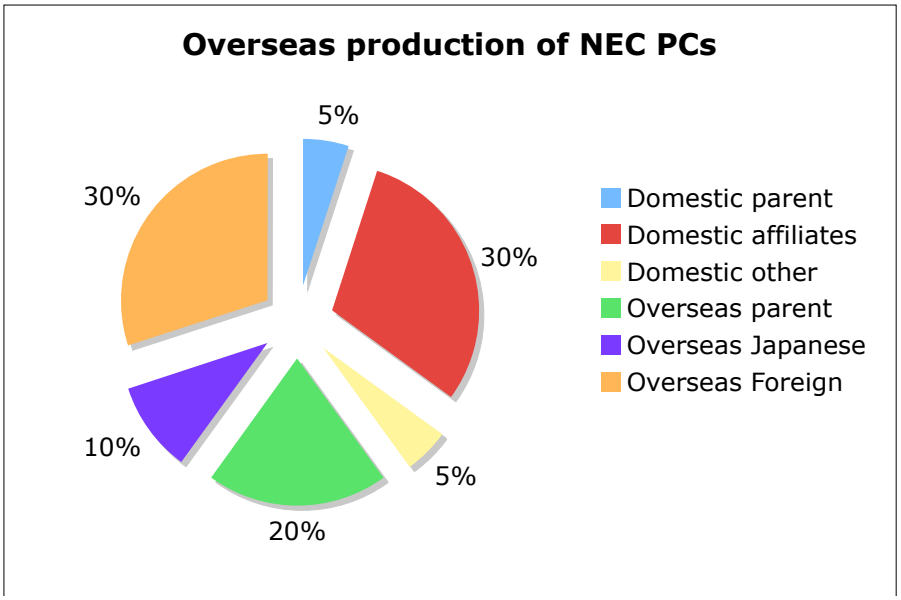

Figure 3: Overseas production of NEC PCs (from Paprzycki 2007)

Even back in 2000, NEC acquired over half of its supplies from outside its traditional *keiretsu*, including some 30% from overseas foreign firms. Clearly, this was not a vertical pyramid seven years ago. Given the major changes in the PC industry, this picture is even more extreme today.

If we move on within the electronics industry to a really high-clockspeed environment such as digital photography, we move even further away from the vertical pyramid model. In this disruptive new digital technology, the Japanese photo camera manufacturer Konica limited its direct involvement to a small number of core competencies (the lens and the auto focus software) and acquired most of the other key components and technologies from outside its *keiretsu* (Paprzycki 2007). Most of these new suppliers are large, independent technology firms, such as semiconductor firms, for whom Konica is "just another customer".

Examples from telecom: strategic communities

Once, NTT was – just like the Deutsche Telecom or AT&T – a completely vertically integrated telecom firm. Today, such firms no longer exist in the industrialised world, also not in Japan.

Nowadays, telecom firms are all parts of multiple networks. These networks are definitely not hierarchical in nature: who is the supplier and who is the customer is unclear, and collaboration takes place on the basis of equal footing. These are not networks, they are more like "strategic communities", as Kodama (2007) labels them. The network shown in Figure 4 shows the strategic community for NTT Docomo in the context of service development for 3G, third generation broadband services.

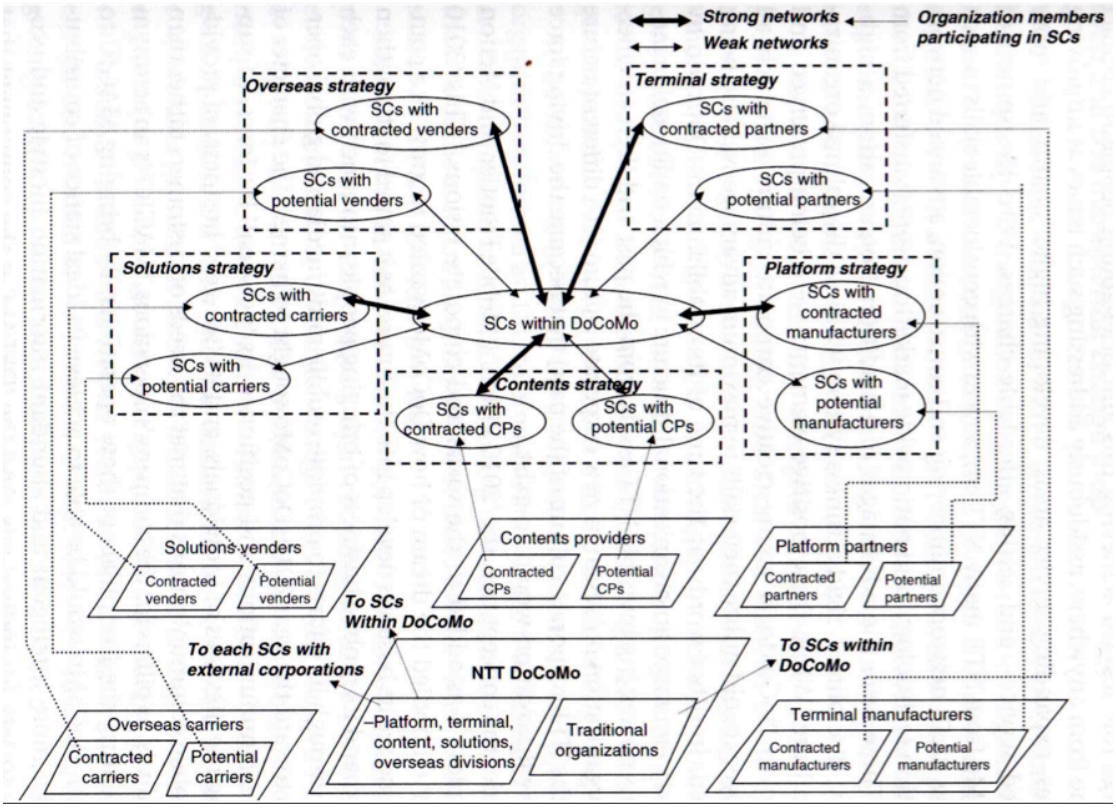

Figure 4: Strategic communities for NTT Docomo's 3G service development (from Kodama 2007)

Example from aerospace: dissolving vertical pyramid *keiretsu*

The fact that in high-clockspeed industries in Japan, the vertical pyramid keiretsu are dissolving or have already dissolved, does not mean that there are no keiretsu left. Fully in line with Fine's "clockspeed hypothesis", we find in low-clockspeed industries that here the focus on process innovation leads to much more stable supply networks. One example is Japan's aerospace sector. In aerospace, products can last up to half a century, so despite all the high tech this is still a low-clockspeed industry. In Japan, 3-4 companies have been leading in this industry for a long time:

1. Mitsubishi Heavy Industries (35% of Japanese aerospace sales in 1997),
2. Kawasaki Heavy Industries (17% of sales)
3. Ishikawajima-Harima Heavy Industries (12%)
4. Fuji Heavy Industries (5%)

However, even here, things are changing. In the global aerospace industry, similar changes are taking place in supply network structures as in the automotive

industry: suppliers account for higher parts of the total costs of goods, and suppliers become more specialized in either system integrators or technology specialists. Especially the 2nd category has to work across keiretsu to leverage its specialized skills (Williams et al. 2002, AT Kearney 2003).

On the other side of supply network, the same thing is happening in aerospace. The US aircraft manufacturer Boeing used to make its planes in the true vertical keiretsu manner, but for its most innovative new plane, the 787, it has asked a whole range of suppliers from around the world to chip in with technology and money. Mitsubishi makes the wing from composite material for this gigantic plane, which is a major technological challenge (Holmes 2007).

Concluding remarks

Japanese supply network dynamics obey the same business logic

This article has illustrated that it is not "Japaneseness" that determines the structure and dynamics of Japanese networks, but rather the same "business logic" that applies elsewhere in the industrialised world, which can be captured in the following two propositions:

Proposition 1: The newer an industry is, the more innovative an industry becomes, the more modular its product architecture is, the more likely it is that its supply networks will resemble "strategic communities".

Proposition 2: The more mature an industry becomes, the lower the rate of innovation it exhibits, and the more integrated a firm's product architecture becomes, the more likely it is that its supply networks will resemble closed, hierarchical, vertical pyramid-type of structures.

Japan's supply networks contribute to its innovativeness

In a recent survey, Japan came out as the most innovative country in the world (Economist 2007). If networks are especially effective to foster innovation, then Japan is world champion networking. This is good news for foreign companies eager to tap into these networks. For the more innovative the industry this supply network will be in, the more open it is likely to be for non-Japanese partners that have an added value for the network as a whole. A fine example is Dutch innovation champion ASML, which is the world leader in the market of lithography machines for chip production. ASML managed to enter the traditionally closed Japanese market, home to its two main competitors Canon and Nicon (Echikson 2000).

Of course, the non-Japanese partner need not be the most innovative one. They may also bring cost-savings to the table (such as with South-Asian low-cost manufacturers) or risk-sharing opportunities, such as with Boeings 787 (Holmes 2007).

Supply network dynamics between poetry and medicine

This paper has argued that culture has no place in the nature of supply network dynamics in Japan. This is different from saying that culture is unimportant in working in supply networks in Japan. Understanding the local culture is essential in doing business with the Japanese, the French, the Americans, the Germans, with any country. National culture is real and company culture is real.

However, culture does not "drive" the nature of supply networks, not even in Japan. Let us say that there are two extremes. One the one end, there is the extreme of full universality. There is only one moon. In medicine, taking out someone's appendicitis is precisely the same in Japan as it is in the Netherlands. On the other end there is the extreme of full "couleur locale". The poem quoted in the beginning of this paper cannot be translated into another language, e.g. English, without making it a different poem. The Japanese language is different from English, so certain ambiguities and sounds are lost to the English reader. And even then, the Japanese connaisseur will know how this poem fits into a whole "community" of other, related poems, in a history stretching several centuries. Where does business organisation fit in? Well, let us end this article with a famous Western poem and paraphrase it in conclusion as follows: *poetry is poetry and business is business*, *and never the twain shall meet*…

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