THE MANUFACTURING PARADOX pdf

1: Productivity paradox - Wikipedia

Whereas manufacturing prices, adjusted for inflation, are down by 40%, the prices of the two main knowledge products, health care and education, have risen about three times as fast as inflation.

Page 25 Share Cite Suggested Citation: A Proposal for a National Forum.. The National Academies Press. Hanifin We are faced today with a paradox: We are a nation at risk and a nation prospering. The para- dox is a glaring combination of a building crisis within conflicting signs of a strong economy. The foreign competition is eating our lunch, yet we can still sit down to a gour- met dinner. Thorough examination of both sides of the paradox is necessary before any real understanding of the state of manufactur- ing is possible. There are many indicators that seem to dem- onstrate that our national economy is quite healthy. Unemployment is very low. Interest rates are low. Performance of many corpora- tions was better than expected at the end of The plunge of the dollar has allowed us to begin to reverse the trade imbalance trend that has hobbled our economy over the last decade. Factories are operating at well over 80 percent of capacity. Many economic prog- nosticators have stated that we have with- stood the most severe blow that the markets stock and global can deliver and come back strong. However, a closer look at other indicators of competitiveness show that the country may not be all that healthy. For many years, we have observed that the U. In each of these years, many dismissed this as a consequence of our tremendous lead in absolute productivity, the development of the emerging industrial na- tions and the rebuilding of those nations deci- mated in World War II. These rationalizations no longer hold; we have now been surpassed as the leader in absolute productivity. We are even beginning to feel individually the impact of our competitive failings. Our stan- dard of living, in terms of average wage, has dropped substantially. Many believe that higher paying industrial jobs are being re- placed by lower paying service economy positions Young, This comparison was based on an exchange rate of yen to the dollar; the comparative buying power of U. However, the paradox has not gone completely unnoticed. Human nature encour- ages us to focus on either the positive or the negative signs and to employ only the infor- mation or data that support the chosen view. To do so would mean that we would either conclude that all is well and ignore the crisis 12 HAN1FIN or conclude that all is lost and ignore the op- portunities. In fact, we must reconcile our- selves to the fact that the paradox is real and we face a situation that is both a problem and an opportunity. A closer look at some key indicators further reinforces this seeming contradiction. Five key indicators of our com- petitive position are growth, jobs, trade, in- come, and productivity. Growth can be measured in terms of either absolute sales or market share. As an ex- ample, a five-year analysis of the semiconduc- tor market Figure 1 shows that the two larg- est American suppliers, Texas Instruments and Motorola, had substantial growth in sales over the last five years 63 percent and percent, respectively. However, some foreign competitors grew by several hundred percent, dropping the American producers from the top two spots in market share to fourth and fifth. As a broader measure of recent growth, sales continue to grow in the manufacturing sector, with factory orders consistently increasing for all but 3 of the past 18 months Figure 2. As another measure of its strength, manufac- turing has maintained a consistent fraction 20 to 25 percent of the U. GNP for the past 35 years. However, its impact on jobs has decreased dramatically during the same pe- riod. Although unemployment is at record low levels, and manufacturing employment is quite strong, many criticize the income levels for our current jobs. Many of these mixed signals can be linked directly to the productivity of U. Although direct labor pro- ductivity is no longer the best measure of competitive strength, it does provide valuable insight. As with other measures of the health of the manufacturing sector, the recent pro- ductivity comparisons are inconclusive. Dur- ing the s, U. Recent years have been more encour- aging, with average annual rates of 3. These rates are still less than many industrialized nations. Nonetheless, recent advances in pro- ductivity may provide an element of opportu- nity. A window of opportunity exists for the American manufacturing community, and for the nation. Recent improvements in trade, wages, sales, and employment all fuel our optimism, and provide necessary resources for further improvements in our competitive position. However, the recent improvements should not be taken as the first signs of an overall victory in the competitive struggle. Rather, they are transients that are more im-

portant in their provision of this window of opportunity. The core elements of our com- petitive weakness still remain. These include both the cultural and environmental struc- tures that enable competition, and technologi- cal and managerial capabilities that provide competitive weapons. Even without the existence of seemingly con- tradictory signals, manufacturing is, by its very nature, extraordinarily complex. The effectiveness of U. These factors are derived from and influenced by the compa- nies, their industries, and their nation. To be effective in this environment, each manufacturing enterprise must have several critical resources: America has a great many resources that pro- vide competitive advantages to our manufac- turing firms. However, there are four environ- mental issues that significantly inhibit the performance of American manufacturing firms and, therefore, require some attention. They are the public image of industry and manufacturing, our primary and secondary educational systems, the American philoso- phy of work, and the financial environment. As affluence spread across the nation, the idea of working in a factory lost its ap- peal. No self-respecting mother advised her son or daughter to become the very best fac- tory worker or manufacturing engineer that he or she could be. Dad and maybe Mom, too worked in the factory so that their sons and daughters could go to college and not have to work in a factory. In- dustry was portrayed in the media as the "polluter of the biosphere," "the abuser of the worker," and the "purveyor of shoddy prod- ucts. Although the loss of the priority and prestige of manufacturing was not unique to this country, it was certainly much more severe here than in other nations. In still other na- tions, the priority on industrialization re- mained high, leading to comparative advan- tages in public policy and the quality and scale of human resources dedicated to manu- facturing improvements. There are signs that the image of manufactur- ing is improving, but, in general, there is not an appropriate appreciation of the dignity, the challenge, the value, and the necessity of indi- vidual contributions and national competence in manufacturing. Education Quality To possess a strong manufacturing sector, the nation must have a technologically competent work force and engineering force. This is especially important if we are to exploit our technological advantages to balance other disadvantages, such as comparative labor rates or cost of capital. A Nation at Risk, the indictment of our educational system, confirmed what many had suspected. Beyond the gen- eral issues of excellence and quality of teach- ing, and the levels of expectations, there are several other serious shortcomings that di- rectly affect the ability to create a competitive work force and an adequate pool of individu- als pursuing careers in engineering and sci- ence. For example, as of , calculus was available to 60 percent of all American high school students, yet only 6 percent completed a course in calculus. Thirty-five states re- quired only one year of math and one year of science for a high school diploma National Commission on Excellence in Education, At the same time, other industrialized nations are teaching statistics to students in grade school, regardless of whether they are des- tined to become laborers or leaders. These shortcomings have not been alleviated in the last five years. Today, less than 10 percent of our high school students take physics. This means that 90 percent of our young men and women may lose the option of a technological education and career before they are old enough to appreciate its value. This loss is further compounded by the demographics of a "baby bust" that is shrinking the college-age pool and further amplifies the relative short- age of engineers and scientists. Today there is a much greater emphasis on consumerism and spending rather than sav- ing, on materialism rather than contribution to society. From the time our children can understand, television tells them that their primary purpose on earth is to consume. This is true whether efforts are focused on a single, com- plex device, such as a robot with vision or advanced controls and mechanisms, or on the whole factory with all its engineering and management challenges. The glorification of the individual is epitomized by the single-handed conquests of such char- acters as Rambo. It also impedes the ability of technological leaders to bring together diverse knowledge and human re- sources on a team so that they can apply ad- vanced systems and technical concepts. It is clear that other countries have institutional- ized teamwork to a much larger degree than we have. One manifestation of this adversarial relationship is the incremental restrictions on job classifi- cation and work rules negotiated over se- quential contract settlements. These have severely hampered the ability of management to respond to competitive situations and to the evolution of advanced manufacturing processes. It is the responsibility of labor leadership to be open to new struc- tures and rules that are fair and equitable and provide greater flexibility and avenues for their membership to contribute as

responsible and committed team members. This is the result of two factors: The financial environment in this country has a profound and negative impact on competi- tive investment by American manufacturing companies. The cost of capital in America is twice as high as in Japan. The high cost of capital and the intense scrutiny of public cor- porations require managers to invest only where there is clear evidence of short payout periods for capital investments and no danger of red ink even for one quarter. This often results in sporadic investments that are nar- rowly focused, typically producing minor business improvements, rather than cohesive investments leading to some revolutionary alteration in the way the company does busi- ness or performs in the marketplace. How- ever, even with the high cost of capital, such revolutionary improvements are, in many cases, still available to manufacturing compa- nies. Because these improvements are typically difficult to quantify, they are seldom used in traditional justifications for capital invest- ments. It has been reported that a new theory now being explored would support invest- ment on the basis of a combination of both financial measures and nonfinancial indica- tors such as those just mentioned National Research Council,

The reluctance to make long-term invest- ments is further reinforced by an executive work force that is vertically and laterally mo- bile and has short-term rewards and yard- sticks. This, and the general attitude of risk avoidance in the executive suite, create disin- centives to long-term objectives and revolu- tionary change. In particular, the possibility of investing in new technologies is often elimi- nated before it is given serious consideration. Technical knowledge and its applica- tion to products and processes are indeed critical to our competitive success. To exploit technology, we must simultaneously accom- plish several interrelated objectives: Technical Knowledge During the last several decades before the s, there was little effort directed at manu- facturing education and research at U. However, in recent years, there have been substantial increases in manufac- turing research and education.

THE MANUFACTURING PARADOX pdf

2: The Proximity Paradox: Balancing Auto Suppliersâ€™ Manufacturing Networks

MANUFACTURING. At Paradox Ventures, we are part owners of an advanced manufacturing facility located in Shenzhen, China. Our dedicated team of specialists work seamlessly together on projects between our USA and China offices.

Industrial MarketView Snapshot U. During the next 10 years, is U. The answer depends on what is being measured. As measured by output, the sector is an economic engine. At the same time, however, job losses in manufacturing are expected throughout the coming decade. This article examines some of the trends behind this paradox and shares some insights into which manufacturing sectors are expected to grow or decline during the next five years. The Projections Oxford Economics forecasts project that over the next 10 years, manufacturing output is expected to increase by 3. That means that manufacturing is expected to make an increasingly large contribution toward positive U. In fact, the share of manufacturing output in GDP is projected to increase from By the measure of output, therefore, manufacturing is expected to be an engine of economic growth over the next 10 years. Expand Close Figure 1: Industries next five years. Oxford Economics forecast However, employment projections for manufacturing tell a different story. The Bureau of Labor Statistics BLS projects employment in the manufacturing sector will decline by , jobs between and Moreover, during that same year span, BLS forecasts that 15 of the 20 most rapidly declining industries in the nation based on employment will be in manufacturing. By the measure of employment growth, therefore, manufacturing is an economic laggard. In part, the dichotomy between employment and output can be explained by observing that many low-skill, labor-intensive industries remain highly vulnerable to continued offshoring or automation apparel-related industries, for example. But the fact is that even fast-growing advanced manufacturing industries are expected to show continued, albeit modest, employment declines. This can be clearly demonstrated by the following three examples: Computer and electronic product manufacturing: Output is expected to accelerate to 4. Computer and peripheral equipment manufacturing: This sector is expected to have the fastest growth in real output among all industries 9. Semiconductor and other electronic components: Again, BLS says output is expected to grow by 4. Which Is the True Measure of Growth? Expand Close Figure 2: Manufacturing plants tend to have many on-site workers that are not directly employed by the company operating the plant. It is not at all unusual that some combination of contract employees, leased employees, temp agency employees, and PEO professional employer organization employees comprise up to 50 percent of the workers on a factory floor. This is particularly true with companies that are addressing legacy union issues either company-specific or prevalent in their industry or community. Theoretically, this complex web of sourced employees is captured by official government statistics. In my opinion, however, some amount of skepticism is probably warranted as to whether or not workers from all of these sources are accurately captured in official government statistics that measure and project manufacturing employment. One final observation on the importance of manufacturing: Oxford Economics forecasts the economic performance of over 3, cities globally. In the United States, one of the greatest predictors of strong economic growth in our metro level forecast models is a strong concentration of advanced manufacturing. The more advanced manufacturing in a region, the more likely that that region will be at the high end of these economic forecasts. Expand Close Figure 3: Obsolescence Necessitates Accelerated Capital Spending Aging physical plant has been a key driver behind several recent industrial relocation projects. Industrial moves are exceptionally disruptive to operations and hence take place very infrequently. More typically, as plants grow, managers and owners tend to improvise solutions â€” e. At some point, these inefficiencies, plus the cost of maintaining aging plant and equipment, begin to severely compromise the competiveness of the operation and a relocation project becomes necessary. This issue of aging and obsolete plant and equipment will likely be a key motivation behind many upcoming projects. Oxford Economics estimates that the average age of structures in the United States nonresidential real estate plus other large industrial equipment classes is currently at its highest since the s. Replacing these aging assets will be a significant contributor to an expected acceleration in capital spending expenditures, and that will include

major new investments in manufacturing facilities. The opportunity to reduce or improve utility costs, regulatory environment, or physical plant is typically far greater than the costs to retain and relocate key plant managers and supervisors. Still another reason why manufacturing search areas might be greater than expected is the absence of suitable real estate product on the market. Finding industrial space is already challenging and will likely get more so as the economy improves. In addition, much of the vacant industrial space on the market is often aged or otherwise obsolete. Opportunities and Strategies Growing output and aging plant would seem to portend lots of relocation activity. But which industries are expected to experience the strongest growth and which might decline? As communities seek to recruit or retain these potential manufacturing relocation projects, what strategies might they consider? One important differentiator in these projects is the distinction between advanced and basic manufacturing. This makes sense as one recalls that a concentration of advanced manufacturing is among the most important indicators of metro-level economic growth. Those states that recognize the importance of attracting and retaining lower-skilled basic manufacturing jobs might want to reexamine if applicable the often-heavy reliance on wages as a measure of project desirability. Regardless of the level of state support, it is often local economic development efforts that can be the deciding factor in whether a community retains an existing facility or wins a new project. Industrial relocation projects have huge year-one cash-outflow requirements â€" inventory needs to be stockpiled, operations disassembled and then reassembled, etc. At the same time, the new facility often needs significant improvements to meet project requirements. As examples, one recent project required installation of an on-site freezer with back-up generator; another needed the facility to be fitted with wastewater treatment equipment to manage sewage and water costs. Local economic development officials working with responsive local developers made a world of difference in helping address these challenges. Local partners are often the ones best positioned to identify grants and other financing mechanisms needed to help capitalize the cost of specialized facility improvements. In these capacities he advised companies on where to locate new facilities e.

3: IIC Conference: The Paradox of Smart Manufacturing - Today's Motor Vehicles

the manufacturing paradox by providing more throughput, quality, simplicity and more, while at the same time contributing to lower costs through advantages like smaller.

Explanations[edit] Several authors have explained the paradox in different ways. In his original article, Brynjolfsson identified four categories to group the various explanations proposed: Mismeasurement of outputs and inputs, Lags due to learning and adjustment, Redistribution and dissipation of profits, and Mismanagement of information and technology. He explained the first two explanations as "shortcomings in research, not practice as the root of the productivity paradox. They propose that there really are no major benefits". Do benefits justify past and continued investment in information technology? Also, computers replaced a sophisticated system of data processing that used unit record equipment. Therefore, the important productivity opportunities were exhausted before computers were everywhere. We were looking at the wrong time period. Another hypothesis states that computers are simply not very productivity enhancing because they require time, a scarce complementary human input. Current data does not confirm the validity of either hypothesis. It could very well be that increases in productivity due to computers are not captured in GDP measures, but rather in quality changes and new products. Economists have done research in the productivity issue and concluded that there are three possible explanations for the paradox. The explanations can be divided in three categories: Data and analytical problems hide "productivity-revenues". The ratios for input and output are sometimes difficult to measure, especially in the service sector. This effect is increased as productivity in a culture becomes less quantitative and more qualitative in nature. In the past, new technology adding vehicles to rail fleets, furnaces to metals factories and the like had a direct and measurable impact on productivity by supporting the production of more saleable units. As the culture has become more information centric however, the impact of technology has been focused more on the nature of services and less on the number of measureable transactions. So it is again hard to measure the profits made only through investments in productivity. There is complexity in designing, administering and maintaining IT systems. IT projects, especially software development, are notorious for cost overruns and schedule delays. Adding to cost are rapid obsolescence of equipment and software, incompatible software and network platforms and issues with security such as data theft and viruses. This causes constant spending for replacement. One time changes also occur, such as the Year problem and the changeover from Novell NetWare by many companies. Other economists have made a more controversial charge against the utility of computers: Much of the productivity from to came in the computer and related industries. The tendency â€” at least initially â€” of computer technology to be used for applications that have little impact on overall productivity, e. Inefficiencies arising from running manual paper-based and computer-based processes in parallel, requiring two separate sets of activities and human effort to mediate between them â€” usually considered a technology alignment problem Poor user interfaces that confuse users, prevent or slow access to time-saving facilities, are internally inconsistent both with each other and with terms used in work processes â€” a concern addressed in part by enterprise taxonomy Extremely poor hardware and related boot image control standards that forced users into endless "fixes" as operating systems and applications clashed â€” addressed in part by single board computers and simpler more automated re-install procedures, and the rise of software specifically to solve this problem, e. Norton Ghost Technology-driven change driven by companies such as Microsoft which profit directly from more rapid "upgrades" An emphasis on presentation technology and even persuasion technology such as PowerPoint , at the direct expense of core business processes and learning â€” addressed in some companies including IBM and Sun Microsystems by creating a PowerPoint-Free Zone [citation needed] The blind assumption that introducing new technology must be good and must lead to higher measureable productivity. The fact that computers handle office functions that, in most cases, are not related to the actual production of goods and services. Adding computer control to existing factories resulted in only slight productivity gains in most cases. Miscellaneous causes[edit] Effects of economic sector share changes[edit] Gordon J. Bjork points out that manufacturing productivity gains continued, although at a decreasing rate than in decades past;

however, the cost reductions in manufacturing shrank the sector size. The services and government sectors, where productivity growth is very low, gained in share, dragging down the overall productivity number. Because government services are priced at cost with no value added, government productivity growth is near zero as an artifact of the way in which it is measured. Bjork also points out that manufacturing uses more capital per unit of output than government or services. Data processing with unit record equipment[edit] Early IBM tabulating machine. Common applications were accounts receivable, payroll and billing. Control panel for an IBM Accounting Machine When computers for general business applications appeared in the s, a sophisticated industry for data processing existed in the form of unit record equipment. These systems processed data on punched cards by running the cards through tabulating machines , the holes in the cards allowing electrical contact to activate relays and solenoids to keep a count. The flow of punched cards could be arranged in various sequences to allow sophisticated data processing. Some unit record equipment was directed by a wired control panel, with the panel being removable, allowing for quick replacement with another wired control panel. In the first completely transistorized calculator with magnetic cores for dynamic memory, the IBM , was introduced. This was partly due to low level software used, low performance capability and failure of vacuum tubes and other components. Also, the data input to early computers used punched cards. Most of these hardware and software shortcomings were solved by the late s, but punched cards did not become fully displaced until the s. Analog process control[edit] Main article: Automation Computers did not revolutionize manufacturing because automation , in the form of control systems , had already been in existence for decades, although computers did allow more sophisticated control, which led to improved product quality and process optimization. Pre-computer control was known as analog control and computerized control is called digital. Parasitic losses of cashless transactions[edit] Credit card transactions now represent a large percentage of low value transactions on which credit card companies charge merchants. Most of such credit card transactions are more of a habit than an actual need for credit and to the extent that such purchases represent convenience or lack of planning to carry cash on the part of consumers, these transactions add a layer of unnecessary expense. However, debit or check card transactions are cheaper than processing paper checks. Online commerce[edit] Despite high expectations for online retail sales, individual item and small quantity handling and transportation costs may offset the savings of not having to maintain "bricks and mortar" stores. Some airline and hotel retailers and aggregators have also witnessed great success. Online commerce has been extremely successful in banking, airline, hotel, and rental car reservations, to name a few. Restructured office[edit] The personal computer restructured the office by reducing the secretarial and clerical staffs. Prior to computers, secretaries transcribed Dictaphone recordings or live speech into shorthand , and typed the information, typically a memo or letter. All filing was done with paper copies. A new position in the office staff was the information technologist, or department. With networking came information overload in the form of e-mail, with some office workers receiving several hundred each day, most of which are not necessary information for the recipient. Some hold that one of the main productivity boosts from information technology is still to come: Cost overruns of software projects[edit] Main article: List of failed and overbudget custom software projects It is well known by software developers that projects typically run over budget and finish behind schedule. Software development is typically for new applications that are unique. This sequence is repeated in successive iterations, with partially completed screens available for review in the latter stages. Unfortunately, stakeholders often have a vague idea of what the functionality should be, and tend to add a lot of unnecessary features, resulting in schedule delays and cost overruns. Debate on existence and scope of paradox[edit] By the late s there were some signs that productivity in the workplace been improved by the introduction of IT, especially in the United States. In fact, Erik Brynjolfsson and his colleagues found a significant positive relationship between IT investments and productivity, at least when these investments were made to complement organizational changes. Second and more importantly, to the extent that there is more rapid growth of labor productivity

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4: The Lean paradox? | Renault-Nissan Consulting

What has changed manufacturing, and sharply pushed up productivity, are new concepts, such as "lean manufacturing." Information and automation are less important than new theories of manufacturing, which are an advance comparable to the arrival of mass production eighty years ago.

Author Archive Have you encountered the following situation? A company has no time for quality, and therefore has more and more business problems. So they spend even more time fire-fighting, and as a result has even less time for quality, and so on. I call this the quality paradox. Bando, who personified the quality paradox. I have to grow the company fast. A company that set out to achieve rapid growth had its growth stunted for life. In a business, clearly, profitability and market share are key measures of success. A culture of excellence is an important enabler to achieve sustained financial results. Both started their automobile manufacturing operations around the same time some decades ago. Toyota decided to follow the path of excellence. Hindustan Motors, because it enjoyed a monopoly for many years in its market, made good money for years despite palming off a shoddy quality product with its once-popular Ambassador brand. The party lasted as long as customers had no choice. During the s competition set in, but the company still refused to pay attention to quality or excellence. The reality turned out to be very different. A widespread phenomenon The quality paradox seems to be a fairly widespread phenomenon. Some companies realize sooner or later that the quality paradox is killing them and try to divert resources, time, and energy from silly fire fighting to preventing the fire in the first place. In reality, however, it was failure to plan for quality that killed the company. How can you have customers without quality, and how can you have a business without customers? However, companies that try to cheat this logic seem to be the rule rather than exceptions. Take time out for qualityâ€”unless you have plenty of time to learn things the hard way.

THE MANUFACTURING PARADOX pdf

5: The Quality Paradox | Quality Digest

The Manufacturing Paradox: Output Up, Employment Down Replacing aging plant and equipment will lead to acceleration in capital expenditure and, in turn, an increasing level of manufacturing relocation projects.

Thanks to an industry recovery from the global financial crisis of and and successful cost-cutting initiatives, earnings and return on capital for the ten largest automotive suppliers are approaching their highs of about a decade ago. Global auto sales remain strong, powered by robust growth in emerging markets. A new financial squeeze is on the way, however. For most suppliers, expanding their manufacturing footprints in emerging marketsâ€”where wages are rising fast and skilled talent is becoming scarceâ€”will add both cost and complexity to global operations. We call the dilemma over how to balance these conflicting demandsâ€”for both cost reduction and manufacturing close to the customerâ€”the proximity paradox. It is one of the most serious management challenges that the global automotive-supply industry will face over the next few years. Pressure to cut prices is unlikely to relent, and avoiding emerging markets is not an option because they are critical to growth. Indeed, China surpassed the U. To understand the challenges that companies are facing and to assess how well they are prepared to confront them, The Boston Consulting Group in partnership with the Fraunhofer Institute for Manufacturing Engineering and Automation surveyed 42 automotive suppliers from around the world. We also interviewed dozens of auto supply executives and industry experts. Our research confirmed that suppliers are struggling with the twin burdens of lowering costs and locating production closer to their customers and are taking action to find an optimal balance between these two demands. But we also found evidence that most companies can better prepare to succeed in the increasingly difficult environment. Some of the key findings of this research are as follows: The cost pressures are real. An overwhelming majority of respondentsâ€”86 percentâ€”said that they are under increased cost pressure from their automotive customers. Industry experts told us that major automakers are rolling out multibillion-dollar programs. The pressures to localize production are real as well. Suppliers surveyed expect to increase the number of their global manufacturing sites by an average of 9 percent over the next five years. The balance in manufacturing capacity is shifting. The automotive-supply industry in Germany alone is projected to lose 35, jobs, including highly skilled blue- and white-collar workers. Efforts to address the challenge are insufficient. Every supplier surveyed agreed that it is important that it adjust its manufacturing network, but our research found that most suppliers lack the organizational capabilities, business processes, and tools to achieve an optimal manufacturing footprint. To keepâ€”and increaseâ€”their market share, automotive suppliers must be able to skillfully balance cost and proximity considerations throughout their entire value chains when deciding where to locate manufacturing. More than ever, suppliers need to have a process in place to reconcile conflicting customer demandsâ€”and to decide where to make trade-offsâ€”as they seek to define the ideal configuration of their manufacturing networks. Network optimization requires a comprehensive and holistic approach, one that encompasses a clear understanding of performance and the right capabilities, methods, and implementation process to achieve results. To be really successful, these programs must be ongoing so that suppliers have the flexibility to adjust their manufacturing footprints in response to shifts in global cost, market demand, and technology trends. For many suppliers, this will require at least some transformation of their organization. In a typical year, suppliers are asked to shave 2 to 3 percent off their prices. But after several years of relative price stability, the coming round of cost reductions is likely to cut much deeper. Suppliers will bear some 55 to 65 percent of these cutbacks. Complexity costs are more difficult to manage than ever. Shifts in the global economy further complicate the tasks of managing the costs and efficiency of production networks. Direct manufacturing cost structures around the world are changing fast, owing to rapidly rising wages in countries such as China and Brazil, volatile energy markets, and swings in currency values. A worsening talent shortage in many emerging markets, meanwhile, can undermine productivity and add unanticipated costs. The percentage of human resources representatives declaring that they are having a difficult time filling jobs in China, for example, rose from 15 percent in to 24 percent in , and in India it rose from 20 percent to 64 percent, according to research by ManpowerGroup. On top of this, most suppliers are

not fully prepared for a raft of technological changes that could fundamentally alter their businesses and production. Electric vehicles, for example, require some entirely different components with dramatically different cost drivers and new supplier relationships. Digital dashboardsâ€”which will be loaded with screens and softwareâ€”will require high degrees of customization based on software, rather than hardware, changes. Such software changes can be made easily without requiring local production. Components such as plug-in displays can be made in low-cost countries and inexpensively shipped. Other technology trends are expected to transform manufacturing itself. Highly computerized, next-generation smart factoriesâ€”connected through the Internet by what is known as Industry 4. This will enable suppliers to adjust their manufacturing networks more quickly. Most suppliers have not yet factored these technological trends into their long-range manufacturing-network plans. Regardless of the practical difficulties of lowering costs and expanding locations, suppliers are being pulled in both directions by their customers. Asked to rate the most important reasons for adjusting their global production networks on a scale of one to six, respondents assigned increasing cost pressure a five, the highest mark given. The second-most-important driver was proximity to end customers. Typically, that means having manufacturing sites close to the assembly plants of automakers, wherever those assembly plants are located. Other considerations, such as the desire to shorten product lead times or reduce the risk of disrupting extended supply chains, ranked relatively low. The essential problem is that production decisions that are intended to cut costs and those made to be close to the customer are based on fundamentally different business rationales. If cost is the primary consideration, most production decisions rest mainly on the basis of total landed cost, which takes into account such factors as labor, logistics, and energy. Economies of scale and the expertise and process capabilities needed to build a plant are also important considerations. Labor-intensive components such as wire harnesses, for example, are typically made where labor costs are lowest, whereas fuel injection systems are built at the site with the best skill base. Commodity sealing products, by contrast, are usually made most economically where the supplier has the largest production capacity and can therefore achieve economies of scale. The logic behind localization is entirely different. Seating modules and dashboards are examples. Unfortunately, suppliers do not always have the leeway to locate production where it makes the most economic sense. In most cases, that means opening more plants in more countries, especially in emerging markets. These days, the main driver of localization programs is a dramatic shift in global demand for cars and light vehicles. In , 53 percent of global auto sales and 56 percent of global production were in the group of developed nations that are known as the triad economies and include Western Europe, the U. By , the share of sales in the triad countries had dropped to 46 percent. The triad economies are projected to account for only 40 percent of sales by By , IHS projects, China will account for 29 percent of worldwide sales of cars and light vehicles, far surpassing Europe 16 percent and the U. Other rapidly developing economies are also gaining ground in the global industry. For example, India is projected to account for 5 percent of sales in , compared with only 3 percent in So far, shifts in production have not kept pace with shifts in demand: But this will change. By , China is projected to account for 29 percent of automotive output, nearly as much as Europe, the U. The contribution of production by all triad economies is expected to drop to 44 percent. In , the suppliers in our study had 66 percent of their manufacturing sites in triad economies. That share is now down to 58 percentâ€”and is expected to decline to 47 percent in The share of manufacturing sites in Canada and the U. The share of sites in Western Europe will also drop to 21 percent. China, not surprisingly, will see significant gains in share, as will Mexico. Over the past five years, the average respondent to our survey added two plantsâ€”many of them through acquisitionâ€”and entered one new region. That translates into a 9 percent overall increase in manufacturing sites for the 42 suppliers surveyed. The number of nations in which respondents have plants also rose by 9 percent. In five years, the number of worldwide production sites is expected to grow by another 9 percent. To get a sense of how these shifts will translate into numbers of facilities, we asked several major suppliers about their plans. Respondents expect to increase the total number of plants from in to in Networks are slowly reaching a size that makes tasks such as increasing productivity, coordinating product development, and simply managing supply chains very challenging, requiring the highest process standards. More triad-country-based suppliers are becoming truly global players. One telling sign is that they are locating more

lead plants in more markets around the world. Lead plants are the core manufacturing operations of every supplier. The number of companies in our study with lead plants in China is expected to double to 16 in five to ten years, and the overall number of lead plants located there is projected to jump by percent over that period. The number of lead plants is expected to rise by 29 percent in Mexico, by 50 percent in Eastern Europe, and by 50 percent in the rest of developing Asia, a region that includes India and the Southeast Asian nations. Emerging markets will not be the only ones to gain. Our survey respondents also expect to increase their number of lead plants in the U. Most of these lead plants will assume global responsibility for manufacturing new products and developing new manufacturing technologies and processes. But several will replace current lead plants in Western Europe. To get a sense of how many facilities may be involved, we asked ten leading suppliers about their plans for lead plants. Companies in this small sample plan to increase the number of lead plants in China from 10 to 25 in five years. Lead plants in Germany will drop from 46 to One German supplier that is planning to shift a lead plant to Eastern Europe indicated that the goals are to reduce cost and improve efficiency. The new plant, according to the supplier, will be more productive than the current German one because work rules are more flexible and new processes and a new organization structure will be introduced. The supplier plans to transfer only production at the outset but to gradually transfer all core functions and skilled positions. The new plant will have few expatriates. In Germany, we estimate, 35, of the current auto-supplier workforce of approximately , could be affected by plant closuresâ€”including some 7, engineers, administrators, and support positions. About one-quarter of those jobs will be in competence centers and lead plants.

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