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11-16-2020

## Grow Local Manufacturing along US/Mexico Border Region for an Integrated Supply Chain in the Post COVID-19 Era

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### Recommended Citation

J. Li, "Grow Local Manufacturing along US/Mexico Border Region for an Integrated Supply Chain in the Post COVID-19 Era," *Smart and Sustainable Manufacturing Systems* 4. Published ahead of print, 16 November 2020, <https://doi.org/10.1520/SSMS20200067>.

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# Smart and Sustainable Manufacturing Systems

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**DOI: 10.1520/SSMS20200067**

Grow Local Manufacturing along  
US/Mexico Border Region for an  
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## TECHNICAL NOTE

Jianzhi Li<sup>1</sup>

# Grow Local Manufacturing along US/Mexico Border Region for an Integrated Supply Chain in the Post COVID-19 Era

### Reference

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### ABSTRACT

The current coronavirus disease pandemic, plus the strong movement of manufacturing reshoring, provide a unique opportunity for many US regions to grow local manufacturers. This technical note attempts to review the current situation and trend in US manufacturing. We then discuss challenges and necessary steps, such as asset mapping, required to grow local suppliers. Suggestions are then made to support growing local suppliers along the US/Mexico border region.

### Keywords

local manufacturer, supplier selection, assets mapping

## Introduction

Modern manufacturers rely heavily on a wide range of suppliers in their process/product innovation. They form into a so-called supply chain<sup>1</sup> and together deliver quality products and services to their customers in a timely manner. Trust among supply chain entities is critical to the free flow of ideas, which are required in the product/service innovation process. This trusting partnership is also important to facilitate the transfer of key activities between manufacturers and suppliers, with a goal to improve business efficiency and lower costs. These activities may include involving suppliers in the product development and innovation, promoting ordering processes that reduce the total supply chain costs, and "entrusting a supplier with the management of inventory levels and some elements of customer service."<sup>2</sup> These activities, if coordinated and optimized, can deliver a range of financial and operational benefits to both parties.

Manuscript received September 21, 2020; accepted for publication October 7, 2020; published online November 16, 2020.

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Most US manufacturing enterprises use a complicated global supply chain to support their global operations and global presence. This offers companies the opportunity to reach new customers in new markets and to lower the overall supply chain costs. However, such a global system is proven vulnerable when suppliers are involved in product design and innovation process because of a lack of intellectual property protection in certain areas and countries. The current coronavirus disease (COVID-19) pandemic further revealed the fragility and the lack of flexibility of such systems when facing natural disasters, especially for industry sectors that matter to national security, such as the healthcare and the defense sectors. Another good example is the 2011 Tōhoku earthquake and tsunami, which significantly disturbed electronic manufacturers whose operations depended largely on suppliers in Japan.

This vulnerability coupled with the strong move at federal and state levels to reestablish the foundation for US manufacturing leadership for “revitalizing American manufacturing”<sup>3</sup> has led to US manufacturers exploring options that support the idea of moving manufacturing operations back to the States. Nonetheless, they often find themselves in an awkward position: there are no quality suppliers available domestically who can supply parts and raw materials with the desired quality at an acceptable cost level to maintain their global business competence. This, coupled with a lack of technical knowhow in the workforce, has been the main barrier for manufacturers to set up manufacturing operations in the States.

As agreed by executives and economic development experts, small manufacturers form the backbone of any supply chains. Because large manufacturers rely on innovation across the entire supply chain to compete in the global markets, the ability for small manufacturers to adopt and lead technology advances is the key for small manufacturers to be qualified and integrated in a supply chain. Small businesses are also important contributors to manufacturing jobs and investment. As pointed in the White House report,<sup>4</sup> “the assets and capabilities of a given community form the foundation for manufacturing production and investment. If we are going to take full advantage of the opportunity in the years ahead, our regions and communities must develop local plans for strengthening manufacturing.”

With the current development in technologies such as additive manufacturing and three-dimensional printing, laser material processing, computer-aided design/computer-aided manufacturing software, and desktop machine tools, manufacturing at a lower production scale in a smaller region is becoming feasible from both technical and economic perspectives. Coupled with the strong “maker movement” in US communities that build upon curiosity, collaborative teamwork, and democracy of creation, Americans are more poised to become a part of the supply chains that support the US innovation economy. The latest developments in information technologies that drive smart manufacturing (or industry 4.0), cloud computing, and predictive analytics further provide an excellent chance to allow these small manufacturers to be included in the supply chain and to support local manufacturing and operations.

Nonetheless, there are challenges and hurdles facing small manufactures for them to be included in the manufacturing ecosystem. Initiatives are being created along the US/Mexico border to fully investigate these challenges and develop systems, tools, and programs to support US small manufacturers in these regions, especially in the post COVID-19 era. A specific focus of these initiatives is to identify assets and gaps at a local region with a goal to grow and qualify small manufacturers as local suppliers for the US original equipment manufacturers (OEMs) in different industry sectors. From the supplier selection perspective, OEMs generally select suppliers using specific selection criteria that involve both technology perspectives and management perspectives. The COVID-19 also certainly would add other perspectives to the selection process, which we attempt to investigate in this article.

## Growing Local Suppliers in the US/Mexico Border Region

As described by Taherdoost and Brard,<sup>4</sup> traditionally, appraisal methods are used in supplier selection through reviewing objective and subjective evaluation criteria. These evaluation criteria are used to qualify and rank suppliers along various evaluation dimensions, with price, quality, and delivery being the most-used dimensions.

Nonetheless, the list of criteria has become increasingly complex because of technological developments such as smart technologies and new concerns regarding social and environmental sustainability. A list of criteria is reviewed and summarized by Taherdoost and Brard. Although this list is comprehensive in terms of covering most concerns OEMs may have in their supplier selection process, a reflection of this list is necessary considering the current reshoring movement, emerging technology, and the impact of COVID-19 to the US manufacturing industry as shown in **Table 1**, in the perspectives of (1) supporting a trusting relationship, (2) adoption of smart technologies, (3) capability, (4) process/product flexibility, and (5) competence.

### **SUPPORTING AN ENTRUSTING RELATIONSHIP IN POST COVID-19 ERA**

Post COVID-19 manufacturing will place a higher demand on an entrusting relationship between suppliers and the OEMs. Although the performance (financial, economic, and social) history of small manufacturers will be an important consideration for OEMs when selecting their suppliers locally, the reliability of small manufacturers facing various uncertainties, i.e., being trustworthy and dependable from the buyers viewpoint, backed up with strong references could be necessary to build up the trusting relationship required. Effective communication will be critical to trust building. One may assume that because language barrier no longer exists, communication between OEMs and local manufacturers may be the least of the problems. This could be elusive though, as small manufacturers do not have experiences in communicating with large OEMs, the differences in technical terms and corporate cultures could hinder effective communication.

### **REGIONAL SMALL MANUFACTURER CAPABILITY**

The capability of small manufacturers in a region could be the most important determining factor when OEMs decide where to locate their manufacturing facilities. For manufacturing reshoring to be possible, regional production capabilities must be analyzed from multiple perspectives, including available processes and capabilities of those processed, production volume, product design capability, family of products, parts, components, and raw materials that can be supplied by the small manufacturers in the region.

Typically termed as asset/capability mapping, the study of process and its capabilities could be the first thing OEMs explore when they decide on the location of their facilities and evaluate potential suppliers. In addition to typical measures used for supplier selection, process and product information are required with necessary details that are updated in a timely manner. Although the process capacity is studied extensively for process planning purposes,<sup>5</sup> to support reshoring, processes available at small manufacturers and their capabilities must be collected and clustered for analysis at a regional level. For this purpose and to support future supply chain integration supported by smart technologies, process modeling should follow an object-oriented data structure that not only provides basic information of a common process in the region but also provides an instance of such object so that the capability of the process can be monitored in real time.<sup>6</sup>

### **FLEXIBILITY OF SMALL MANUFACTURERS**

It is expected that in the post COVID-19 era, OEMs will give greater weight to the flexibility criterion when selecting their suppliers. The flexibility herein refers to process flexibility, management flexibility, and design flexibility. Specifically, suppliers are expected to provide product customization in terms of size, shape, color, design, label service, flexible order quantity, rapid response and communication (respond time, information, language), industry knowledge, and response to change. A configurable process<sup>7</sup> that can be quickly configured/reconfigured to process multiple materials, shapes, and sizes would be much preferred to a dedicated process without flexibility. The ability of a supplier to modify an existing product or formulation of an entirely new product that satisfies a newly defined customer want in a short period of time is essential for suppliers to remain in business when facing natural disasters such as the COVID-19 pandemic. Management flexibility is important to support process and design flexibility. On one hand, a flexible management team supports smooth and rapid communication with OEMs; on the other hand, flexible skill sets in the management/engineering team support the ability of the supplier to analyze and improve existing processes within its company for optimization and to

**TABLE 1**

Supplier selection criteria list<sup>4</sup> and their relation to trusting relationship, smart tech, capability, flexibility and competence in the post COVID-19 era

#	Criteria	Definition	Post COVID-19 Requirement
1	Performance history	The performance history of the supplier in the financial, economic, social, organizational, and societal area.	Trusting relationship
2	Warranties and claim policies	The superiority of the specified written guarantee that promises to repair or replace product if necessary within a specified period and also the claim policy as a formal request for coverage or compensation for a covered loss or policy event.	
3	Professionalism	The supplier's competence or skill expected of a professional.	
4	Reliability	The supplier's quality of being trustworthy and dependable based on the references (buyers feedback), financial stability (capital, annual turnover), past and current business partners, company organization and personnel, diversity of ownership, and cultural awareness.	
5	Labor relations record	The supplier's relationship between management and its workforce.	
6	Commercial plans and structure	The supplier's format statement of business goals, reasons they are attainable, and plans and infrastructure for reaching them.	
7	Risk factor	The risk factor is a measurable characteristic or element, a change that can affect the value of an asset, such as exchange rate, interest rate, and market price.	
8	Management and organization	The reputability of the supplier's management team and the efficiency of their decision making to resolve issues in order to be both effective and beneficial.	
9	Supplier's profile	The superiority and reputability of the supplier's status, past performance, finance, certificates, and references.	
10	Reputation and position in industry	A ranking and reputation of a brand, product, or company, in terms of its sales volume relative to the sales volume of its competitors in the same industry.	Smart technology
11	Attitude	The attitude of the supplier while you are in contact with them such as politeness and confidence.	
12	Mutual trust and easy communication	The level of trust on the quality of the work provided by supplier. And refers to the obligations owed between the buyer and the supplier. The easy communication is a simple exchanging of information between the firm and the supplier.	
13	Communication system	The communication system of the supplier, including information on progress data of orders.	Capability
14	Delivery	The ability of the supplier to meet specified delivery schedules which include lead-time, on-time performance, fill rate, returns management, location, transportation, and incoterms.	
15	Production capacity	The volume of products or services that can be produced by a supplier using current resources.	
16	Technology and capability	The technological capability of a supplier and ability to acquire new technologies and technical resources for research and development practices and processes.	

TABLE 1 Continued

17	Repair service	The ability of the supplier to restore something damaged, faulty, or worn to a good condition.	Flexibility
18	Geographical location	The geographical location of the supplier.	
19	Service	The ability of supplier to provide intangible products including the customization (size, shape, color, design, OEM, label service), minimum order quantity, communication (respond time, information, language), industry knowledge, flexibility, and response to change.	
20	Process improvement	The ability of the supplier to identify, analyze, and improve upon existing business processes within its company for optimization and to meet new quotas or standards of quality.	
21	Product development	The ability of supplier to modify an existing product or its presentation, or formulation of an entirely new product that satisfies a newly defined customer want or market niche.	
22	Environmental and social responsibility	The supplier's responsibility to use natural resources carefully, minimize damage, and ensure these resources will be available for future generations.	Competitiveness
23	Quality	The ability of the supplier to meet quality specifications consistently, which include quality features (material, dimensions, design, durability), variety, production quality (production lines, manufacturing techniques machinery), quality system, and continuous improvement.	
24	Cost	The cost is a monetary valuation of effort, material, resources, time and utilities consumed, risks incurred, and opportunity forgone in production and delivery of a good or service.	
25	Price	The price criteria include unit price, pricing terms, exchange rates, taxes, and discount.	

Note: Shading shows the relationship between supplier selection criteria and the five perspectives.

identify or develop new processes to meet new quotas or standards of quality. Management flexibility is also essential to quick delivery and small order quantity in shortened lead time suppliers may require facing natural disasters.

**COMPETENCE CRITERIA IN A REGION**

Traditional supplier selection emphasized the key business competence in cost, price, and quality of supplies. Without a doubt, these dimensions will remain critical in the post COVID-19 era when OEMs select their suppliers locally. The cost of supplies has a lot to do with the location of the region, which affects the labor, land, transportation, and raw material costs. In this regard, the US/Mexico border region has special cost advantages over other regions in terms of availability of young people, availability of land with lower cost, and the Maquila systems as the result of North American Free Trade Agreement (now replaced with United States–Mexico–Canada Agreement). In terms of quality, the ability of the supplier to meet quality specifications consistently could be a challenge for small manufacturers because of the lack of a quality management system. Local certification/training programs may need to be developed and offered to employees at small manufacturers to ensure quality features (material, dimensions, design, durability) and continuous improvement procedures consistently meet OEMs' requirements.

## SMART MANUFACTURING TECHNOLOGY

The previously mentioned criteria can be significantly enhanced through adoption of emerging technologies,<sup>8</sup> such as smart technologies, autonomous technologies, augmented reality, cyber manufacturing, additive manufacturing, and artificial intelligence. The latest development in these areas allows online monitoring of a manufacturing process in terms of its capability and process conditions. Through cyber manufacturing systems, smart technologies enable streamlined information sharing through the entire supply chain, supporting entrusting relationships, responsive communication, and globally optimized supply chain operations. Augmented reality coupled with autonomous tech, provides resilience of manufacturing systems to natural disasters. For example, digital twin,<sup>9</sup> a method developed to create “digital replications of living as well as nonliving entities that enable data to be seamlessly transmitted between the physical and virtual worlds.” Digital twin could be an excellent technology for small businesses to adopt in supplier qualification process for OEMs to understand, monitor, and optimize the processes at suppliers’ facilities. Suggested by Furtado et al.,<sup>10</sup> digital twin can be used to create employee and workspace ‘pods’ to enable shop floor physical distancing. Although digital twin-enabled pods may become a normal pattern in the future of work floor design, the readiness of small manufacturers and the performance of operators in such an augmented environment are yet to be seen. Training programs provided by certified third parties may be deemed necessary.

## Conclusion

The conclusion that can be drawn from what we observed so far is that, although the COVID-19 pandemic has significantly disrupted US manufacturing in general, it may have forced executives and policy makers to seriously consider growing local suppliers for the national security purposes and to develop the resilience in the manufacturing system when facing natural disasters. We suggest the following activities for growing local suppliers: (1) comprehensive asset/capability mapping of the small manufacturing for supplier section and gap analysis; (2) developing smart supply chain information technology framework to increase visibility of small manufacturers, to support streamlined matchmaking, and to enhance trusting partnership; (3) providing certification program to qualify/certify small business as supplier for selected manufacturing sectors; (3) educating and preparing workforce needed for small manufacturers; and (4) providing technical support for small manufacturers.

## ACKNOWLEDGMENTS

This work is supported by DoD MEEP program, under award # N00014-19-1-2728.

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