White Paper

Recovery to Restart: How Michigan's Supply Chain is Responding to Disruption.

Presented with Fraunhofer USA

Introduction

The ongoing global COVID-19 pandemic does not yet allow a look into the future. Infection incidence and rates are neither predictable nor can they be effectively controlled. As a result, there is still uncertainty around how the effects of this health crisis will impact our societies and economies long term. This paper provides initial insights into what conclusions can be drawn from the pandemic's first wave and how Michigan industries can be prepared for disruptions in the future. The paper addresses the impact of the COVID-19 pandemic on Michigan's supply chains and how the state managed through the initial first wave (recovery), what was learned, and how the state can best move forward (restart). However, in addition to the numerous challenges posed by the COVID-19 pandemic, silver linings have been identified.

This paper is based on an aggregate of voices from an Industry 4.0 Roundtable at Automation Alley's Integr8 Conference, which took place in November of 2020, and is produced by Fraunhofer USA and Automation Alley. Fraunhofer USA, a legally independent US affiliate founded by Fraunhofer-Gesellschaft, is an R&D organization working with industry, universities, and state and federal governments on contract research projects. These research efforts are geared entirely to people's needs: health, security, communication, energy and the environment. Contributions to this paper were made by experts from Fraunhofer USA and Fraunhofer-Gesellschaft.

Current Challenges:

The COVID-19 pandemic has created immense social, economic and health challenges across Michigan and for the entire global population. This worldwide disruption has had a significant impact on people's daily work situations across multiple industries, including advanced manufacturing, which accounts for 14% of the state's total workforce and 19% of its GDP. COVID-19 has limited industry's access to national and international supply chains and has forced new work arrangements on the shop floor to comply with health and safety protocol. As a result, companies are working permanently in crisis mode and strategies are being adjusted at all levels of the value chain. Supply chains that functioned perfectly yesterday may no longer be possible today due to new import regulations or rising infection rates in export or import countries. This results in short-term supply bottlenecks or high stock levels, which can lead to a production stop or losses in sales and possibly even customer/supplier relationships. The measures to be taken are further complicated by different regulations across nations and states, which are constantly changing. As a consequence, the use of resources and employees can no longer be planned. These challenges lead to companies making new strategic decisions on an almost daily basis in order to maintain their operational businesses. Key issues are securing the workforce and providing personal protective equipment (PPE).

How Resilience Helps in the Event of Disruptions:

One way to overcome such disruptions is the principle of resilience. The term resilience originally refers to psychology and describes the ability of a human being to withstand mental disruptions. Resilience therefore describes a person's ability to regain mental health after a serious life crisis. In the context of production, resilience is to be understood as the ability of a company to permanently adapt to internal and external changes and disturbances [1]. The goal of resilience management is to quickly return to the original state after a disruption and to arise strengthened from the crisis.

Besides the current COVID-19 crisis, other central drivers for the necessity of resilience management in production are: a considerable increase in complexity and fragility due to the continuing interlinking and digitalization of production assets; an increase in the volatility of political, economic and ecological contexts as well as the supply of raw materials; and demographic change and increasing qualification requirements.

How can business owners integrate resilience into their own companies? The resilience cycle with its five phases (see figure 1) provides an orientation guide for the integration of resilience management in a business [2]:

Figure 1: The Resilience Cycle [2]

In the first phase, **Prepare**, arising and likely occurring disruptions are identified and divided into foreseeable and unforeseeable events. In addition, it is important to note how fast a disruption will evolve. For example, a catastrophic earthquake is in most cases unpredictable, but a hurricane hitting the U.S. coast is predictable with a certain advanced warning, so that measures can be initiated. In summary, the Prepare phase is about creating awareness of various types of events.

After the events have been identified in the Prepare phase, a risk assessment of the expected consequences of a disruption follows in the **Prevent** phase. This serves to minimize risks, if possible, and to identify vulnerabilities in the company or supply chains. It is important to assess the risks according to probability of occurrence and their consequences. Like all phases of the resilience cycle, the Prevent

phase should be conducted several times in order to reassess and evaluate the risks at defined time intervals.

The **Protect** phase follows the Prevent phase and aims to eliminate the identified vulnerabilities and to develop solution strategies for the identified risks. If, for example, information had been obtained before the outbreak of the pandemic about where or how to obtain PPE more rapidly, the step of procuring PPE would have been much faster and more efficient. However, the procurement of PPE is only one of many possible measures. In the Protect phase, the key challenge is to perform these steps as economically and efficiently as possible so that the company is as prepared as possible in the event of a disruption, but does not waste too many resources preparing for events that do not occur at all. In summary, a robust infrastructure with various solution strategies must be developed and implemented in the company core strategy.

In the event of a disruption, the **Respond** phase is initiated immediately. The extent of the damage is analyzed and evaluated as quickly as possible. The company goes into immediate crisis mode and activates its crisis management, which was prepared in the Protect phase. Through targeted resilience management, a company should be able to react quickly to the disruption and initiate countermeasures. In the context of a supply network, this could be, for example, alternative routes or alternative transportation or alternative and/or local suppliers.

Once the respond measures have been initiated, the aim in the **Recover** phase is to return to the initial state as quickly as possible, i.e. to ensure the company's operability and liquidity. This can mean, for instance, restarting production or exporting products again.

What Silver Linings Has COVID-19 Presented and How Can the Region Capitalize on Them?

In addition to the supply chain challenges posed by COVID-19, such as limited access to resources, limited workforce and low predictability of demand (see Section 1), the pandemic also poses some silver linings. Roundtable participants identified three positive developments for Michigan.

Revealing potentials and problems – Initiated by the crisis and the associated challenges, companies have to reconsider their skills and competencies. On the one hand, new, previously unknown potentials or best practices could be identified: For example, human capital and traditional production were recognized as key success factors that could be combined with digital solutions and increased interconnectivity (i.e. Industry 4.0) to create a leverage effect in enhancing the resilience of supply chains [3]. Due to the need to keep social distance, new work systems with multiple shifts were

implemented, which increased the flexibility of manufacturing and made the company overall more resistant to fluctuations in demand.

On the other hand, the pandemic also highlighted already known problems, such as the strong dependence on Asian markets, which led to programs to support local industry, ultimately leading to greater regionalization and a shift towards on-demand production [4] instead of over-capacity. Through a localized sourcing strategy, the overall supply chain complexity and integration is minimized, thus reducing the risk of disruption and containing the effect of a disruption within the area [3]. The crisis also showed that much of the necessary flexibility of manufacturing was gradually lost due to the focus on lean manufacturing, making the supply chain prone to the challenges posed by the virus [5]. The pandemic therefore also represents an opportunity to exploit undiscovered potential and uncover problems.

Outside pressure leads to evolution - Furthermore, the challenges of the pandemic lead to a higher awareness of new technologies and to a higher priority of long-term strategies such as resilience for supply chains [5]. The losses in the core business of some industries have forced companies to think of innovations and transformation projects, which are hardly ever implemented in economically stable phases. However, the sharp drop in demand [6] in many industries has given long-term transformation projects a new necessity and thus high priority, which helps to strengthen sustainable competitiveness and therefore consolidates companies in the long term. The same applies to the digitalization driven by the pandemic [3].

Due to the necessity of social distancing, digitization projects in companies were strongly promoted: On the one hand, COVID-19 led to a broad adoption of digital twin applications or AI-supporting manufacturing software. On the other hand, the use of digital communication media has increased, reducing the need for business travel and thus contributing to overall productivity.

Collaboration and Cooperation – Last but not least, the pandemic has also been a driving force of internal and external communication and collaboration [7], also driven by the growing acceptance and ease of use of digital communication media such as Zoom. Increasing networking was one of the reasons for the initiation of many new projects and the establishment of partnerships and networks, resulting in greater cohesion, especially among SMEs.

The collaboration among supply chain companies also simplifies foreseeing possible demand shifts and preventing potential threats [3]. In addition to the increasing activity in corporate networks, new connections to universities and schools were reported, which opens up new opportunities for recruiting and research activities.

How Will Jobs Look Different in Manufacturing in 2021 and Beyond?

Roundtable participants identified social distancing as a key factor that will continue to impact the workforce and will lead to a multitude of changes in the characteristics of jobs in the future, particularly in the production industry. (See figure 2).

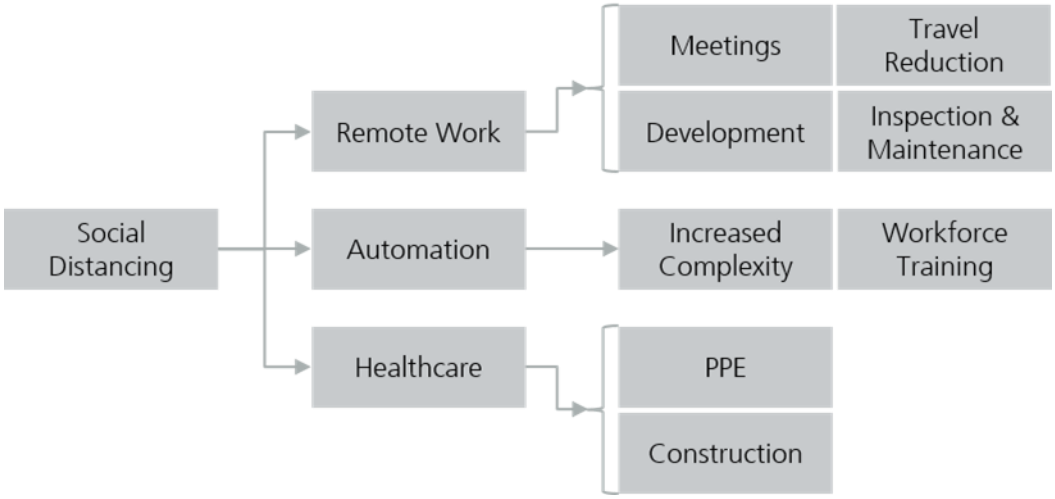

Figure 1: Cascading effects of the Covid19 pandemic on jobs in the present and future

For one, all jobs experience an increase in the use of digital communication tools. 2020 has established remote communication as a cheap, safe and effective mean of exchanging information – be it via Microsoft® Teams, Zoom™ or other 3rd party providers of Voice Over Internet Protocol (VoIP). These tools have two main use cases. On the one hand they are used for meetings, lowering the time and effort necessary to conduct them. Going forward this fact will perpetuate the already dramatic reduction of business travel.

On the other hand, companies increasingly use these tools as a way of conducting development around the clock around the globe and an enabler for remote execution of inspection and maintenance tasks. This trend will continue in 2021 and beyond, empowering the workforce to have meaningful impact on the on the ground without everyone being physically present. The resulting work profile will therefore feature a mix of online and offline work.

Another consequence of the social distancing requirement is an additional push towards more automation because lower density of workers on the ground requires a higher level of automation to produce the same physical output. Automation mostly affects redundant and repetitive work and therefore reduces its relevance for the workforce. The requirement profile for employees will consequently shift towards more complex tasks requiring additional education and a higher degree of creativity and responsibility. On-the-job training within a system of continuous learning will become the norm for large parts of the workforce.

Lastly, on-premise work is and will continue to be impacted by enforcing additional PPE and constructional modifications that enable social distancing.

How can we spearhead best practices to amplify positive outcomes for our region and state related to supply chain resilience?

The COVID-19 pandemic has shown just how much we rely on the dependability of our supply chains when it comes to key goods. The fast and extensive propagation of the novel COVID-19 virus has created wild fluctuations in demand and large-scale disruption in global supply chains. This has led to shortages, price gouging, and competition between governments and industry for ever shrinking supplies. This has exposed weaknesses in the current mindset surrounding supply chain best practices.

Management executives need to understand that supply chains need to be responsive, that new technologies will be critical for resilience and that regional cooperation will reduce risk. Companies successful in these efforts will need to champion them with their government so that financial and legislative support will allow wide scale adoption.

Paradigm Shift – Current supply chains are excellent at focusing on speed and efficiency. They have been built to be as lean as possible. Saving on cents is great when everything runs stably. The pandemic has shown that these systems are not built to respond to change and company leaders with a shift in the current paradigm. Our roundtable identified two key areas that executives should be exploring.

- First, the process of sourcing should be reviewed. Companies need to expand the number of sources they have for vital components. The requirements placed on these sources should also be revisited so that that smaller and more agile suppliers can be used.
- Second, a better ratio of onshore, nearshore, and offshore suppliers should be established. Adopting these strategies as quickly as possible will allow companies to be more responsive in the face of future disruptive events.

Technological Innovation – Once companies accept the shift in strategy for their supply chains, they will need the tools to implement these changes effectively. This is where companies that see the value of Industry 4.0, digitization, and Big Data will be most successful. Data analytics and simulations will especially play a role in companies quickly and transparently adopting new policies. Management teams should be looking to invest in increase data capture in the short term, so that better decisions can be made in the long term. These leaders can expect additional local and regional capabilities from their suppliers as these smaller manufacturers also adopt new technologies. One excellent example of this is Automation Alley's Project DIAMOnD. Automation Alley has created Project DIAMOnD (Digital, Independent, Agile, Manufacturing on Demand) in an effort to create the largest 3D printer network in the U.S. that's supported on a blockchain technology platform. The goal of Project DIAMOnD is to build a product independence pipeline with 300 of the region's small and medium-sized manufacturers and inspire a new generation of manufacturing. And while it begins with PPE, the plan is to grow the pipeline for future projects that strengthen manufacturing and supply chain might in Michigan and throughout the U.S. and lessen our reliance on foreign products. Efforts like this show the importance of regional cooperation moving forward.

Regional Strength – One of the most common responses during our roundtable was that companies need to work together with their local and regional suppliers. When the next disruption comes companies with better relationships with suppliers at every tier will be able to more quickly respond. It is important for policymakers to understand that many businesses are still analyzing the impact of COVID-19 on their financials and their supply chain plans. These companies will need support both financially and legislatively to overcome our current disruption and to become strong enough to survive another. This is especially important for small-medium sized suppliers. We know that these companies will be hardest hit by job losses and without assistance this will affect the entire supply chain. Moving forward, collaboration and communication between businesses and policymakers will lead to stronger economic resilience for regional, country, and global markets.

Wrap Up:

Initiatives & Next Steps

To successfully navigate through and out of the COVID-19 crisis, companies are not on their own. Several national and international research initiatives are available to support companies in integrating the principles of resilience into their business strategy. Three initiatives driven by Automation Alley or Fraunhofer-Gesellschaft are presented in the following. To learn more about Fraunhofer USA please visit Fraunhofer.org

Project DIAMOnD: https://automationalley.com/Initiatives/PPE-Resilience-Grant-Program.aspx

Automation Alley has created Project DIAMOnD (Digital, Independent, Agile, Manufacturing on Demand) in an effort to create the largest 3D printer network in the U.S. that's supported on a blockchain technology platform. Project DIAMOnD is an Automation Alley program providing grant funding to Oakland and Macomb County, Michigan companies to help produce PPE when needed while simultaneously ensuring the region has the digital capabilities necessary to be Industry 4.0 ready. Companies approved will receive a free state-of-the-art 3D printer to use as they wish until they are called upon to produce PPE as well as training on Industry 4.0 leadership and how to operate the new technology. The project aims to accelerate digital transformation among Michigan manufacturers and strengthen supply chains. Project DIAMOnD is funded through the $10 million grant Automation Alley received from Oakland County and $2 million grant from Macomb County in June 2020 to help each county's manufacturing base purchase and implement Industry 4.0 technologies for direct support of manufacturing personal protective equipment (PPE) for the COVID-19 pandemic. Because Project DIAMOnD certifies participating businesses as "essential," the opportunity could mean the difference between growing a business and going out of business. "3D printing is accelerating quickly, and Project DIAMOnD will have Michigan setting the pace," says Tom Kelly, Automation Alley executive director and CEO. "The goal of Project DIAMOnD is to build a product independence pipeline with 350 of the

counties' small and medium-sized manufacturers and inspire a new generation of manufacturing. And while it begins with PPE, the plan is to grow the pipeline for future projects that strengthen manufacturing and supply chain might in Michigan and throughout the U.S. and lessen our reliance on foreign products."

Project Spaicer: https://www.spaicer.de/en/

In a globalized and networked economy, production interruptions, including the interruption of supply chains, have been the leading business risk for many years. The ability of a company to permanently adapt to internal and external changes and disruptions is the "search for resilience." Reinforced by a significant increase in complexity in production due to Industry 4.0, resilience management is thus becoming an indispensable success factor for production companies. The SPAICER project develops a data-driven ecosystem based on life-long, collaborative and low-threshold Smart Resilience Services by using leading AI technologies and Industry 4.0 standards with the aim of anticipating disruptions (anticipation) and optimally adapting production planning to active disruptions at any time (response).

Project ReSyst: https://www.produktion.fraunhofer.de/en/research/futuretopics/resyst.html

The Fraunhofer Innovation Program Resilient Value Creation Systems (»RESYST«) addresses the requirements of Germany as a business location for resilient and dynamic value creation systems while maintaining high productivity and individualization. Resilience to all kinds of failures is becoming a decisive competitive factor. Against the background of the immense economic damage caused by the pandemic situation, almost all manufacturing companies are forced to rethink their risk management strategies that have been used up to now. Traditional business models are often inadequate to meet the requirements of crisis phases. This is mainly a matter of implementing a resilient behavior in the area of risk management and avoiding uncontrollable production downtimes and disruption-related excessive additional expenses in work organization.

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Authors

Russell Zarras, Fraunhofer USA, United States

Kristian Arntz, Fraunhofer Institute for Production Technology IPT, Germany

Marcel Wilms, Fraunhofer Institute for Production Technology IPT, Germany

Oliver Henrichs, Fraunhofer Institute for Production Technology IPT, Germany

Leonie Krebs, Fraunhofer Institute for Production Technology IPT, Germany

Roundtable Participants

Brent Burns, Michigan Technological University
Casey Denoyer, Office of Rep. Haley Stevens
Frank Henderson, Henderson Sewing
Horace Tiggs, Accenture
Leonie Krebs, Fraunhofer IPT
Nicole Kampe, Automation Alley
Samuel Hoff, Patti Engineering, Inc.
Suzanne Kopcha, Siemens
Vicky Rad, Macomb County
Carla Bailo, CAR
Chris Bala, OPS Solutions
Dan Fuhrmann, Michigan Technological University
John Kovac, Microsoft
John Paul Rea, Macomb County
Kristian Arntz, Fraunhofer IPT
Kyla Carlsen, Co.Act Detroit
Matthew Wallace, DXM
Sohum Pawar, Office of Mich. Rep. Elissa Slotkin
Bryce Mulligan, NLB Corporation
Cynthia Hutchison, Automation Alley
Dan Friz, Sharp Tooling Solutions
Irene Spanos, Oakland University
Jennifer Tisdale, GRIMM
Mark Madsen, Behco
Oliver Henrichs, Fraunhofer IPT
Sridhar Kota, Mforesight
Arnd Herwig, Brose
Francisco Betti, World Economic Forum

Justine Burdette, The Right Place, Inc.
Kent Dose, Mahindra
Lisa Lunsford, GS3
Nick Gaziorowski, Manpower
Nickolas Justice, North Carolina State University
Russell Zarras, Fraunhofer USA
Tom Mahoney, Mforesight
Tripp Burd, Markforged
Alex Penades, Jeanologia
Billy Morrison, Oliver Hatcher
Gary Krus, Hirotec America
Heiko Wenczel, Epic Games
Ian Cronin, World Economic Forum
Leonard Marano, Gerber Technologies
Marcel Wilms, Fraunhofer IPT
Matt Gannon, Markforged
Natalie Chmiko, MEDC
Paul Ryznar, OPS Solutions, LLC
Tom Kelly, Automation Alley
Tom Luttrell, Shiloh Industries, Inc.
Elissa Slotkin, US Congresswoman, Michigan
James Jackson, Office of Senator Gary Peters