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Discussing labour markets and supply chain resilience with Professor Anna Nagurny

Skills shortages in the logistics sector, notably truck drivers and warehouse staff, became headline news during the pandemic - highlighting how labour supply can impact supply chains as a whole. What steps can governments and companies take to help shore up supply chains? We speak to Professor Anna Nagurny, author of '[Labor and Supply Chain Networks](#)', to find out.



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Professor Anna Nagurney currently holds the position of Eugene M. Isenberg Chair in Integrative Studies at Isenberg School of Management, the business school of the University of Massachusetts Amherst.

Professor Nagurney's research interests and expertise span a wide spectrum of logistics and supply chain areas, including supply chain networks and disruption management, humanitarian logistics, sustainability and environmental policies, perishable product supply chains, as well as supply chain network design for critical needs and health care products.

Nagurney is also known as an academic author, having published texts in recent years concerning the perishable product supply chain, and network economics and supply chain.

Her most recent book, '[Labor and Supply Chain Networks](#)', originally published in 2022, updated in 2023 and released in paperback this month, contains numerous models and analyses as it aims to solve supply chain problems where labour resources are a prominent variable.

Despite the huge impact that labour supply can have on supply chains, skills shortages have arguably been snubbed in supply chain discourse to some extent, with themes like automation, visibility and digitalisation more prominent.

We thus sought to reach out to Professor Anna Nagurney to highlight the importance of the labour market to supply chains, and learn what actions can be taken with regards to labour to help make supply chains more resilient.

Read on to learn:

- How companies changed working practises after skill shortages came to the fore during the pandemic
- What investments can be made to boost labour

- Whether business cycles can influence the supply of labour
- How automation may impact the dynamics of the relationship between labour and supply chain networks

Thanks for taking the time to answer our questions Anna. It appears that the developments of the pandemic and the emphasis on labour shortages during this time in part inspired you to write the book. Since the end of the pandemic period, to what extent has industry learned about the importance of labour to supply chains, and changed practices as a result?

Yes, most definitely, I was inspired by what I was seeing in the pandemic, with many workers getting ill and, sadly many perishing, from those in the agricultural and food processing industries to healthcare workers.

It struck me deeply that so many sectors of our global economy were affected by labour shortages as well as associated decreases in productivity. Supply chains became regular front page news items.

At the same time, much of the analyses and prescriptions for enhanced supply chain performance had ignored the critical human resource of labour. Fueled by adrenaline and the desire to add knowledge to this area and also to help, I undertook many studies and the book was the outgrowth.

The book continues to resonate now with many insights because of wars and climate change and associated labour issues including shortages. When produce rots in the fields, as global poverty rises, because workers aren't available, that affects me deeply.

It was very interesting to see how firms responded to their workers in the pandemic, a global healthcare disaster. Some invested in workers' health and safety and increased the minimum wage for their workers (Walmart, for example); some offered bonuses to frontline workers and paid sick leave.

The investments in improved worker safety and better pay was in response to great  in the pandemic, and

retraining and reskilling their workers was of importance and emphasised health and safety. And a [more recent survey of 2,000 supply chain executives](#) found that a majority consider hiring and keeping qualified workers as this year's major challenge.

Labour shortages add to supply chain vulnerabilities, and they are apparent in durable goods manufacturing, wholesale and retail, and, of course, in health services, as well as in logistics.

The message of recognising workers as essential resources in supply chains needs to be broadcast more loudly and emphatically, however. And this is one of the reasons I wrote my book. The White House, [in its brief on supply chain resilience published in November 2023](#), did not even mention labour or workers but did mention raw materials. **We have more work to do and I will continue to do it.**

What effective investments can companies make to boost labour productivity when access to labour is restricted?

One has to realize, and I emphasise this in my book, that there is synergy between productivity and people – higher levels of productivity allow companies to reinvest in human capital and smart investments result in higher labour productivity.

What are some of these smart investments? Investments in labour productivity can involve investments in tangible assets in the supply chain, investments in intangible ones such as R&D as well as investments in human capital by enhancing the acquisition of skills and education.

Also, as we saw in the pandemic, investments in workers' health and safety in their work environments can not only reduce stress, but can increase workers' productivity. Healthy workers are happier and more productive.

What factors make a supply chain more or less resilient to disruptions in labour supply?

Excellent question! First, let me step back. It is important to define resiliency in terms of performance of the supply

various supply chain stakeholders and links to economic activities such as production, storage, transportation, etc.

A supply chain network is said to perform “better” if, on the average, it can handle a higher demand for products, at a lower price. Resiliency that we then consider is of two types: resiliency in terms of labour supply and resiliency in terms of labour productivity.

We find that, if labour is allowed to “move” (be reallocated) to different activities in the supply chain (assuming that workers have the right skillsets) then the supply chain network is more resilient in terms of disruptions to labour supply and to disruptions to labour productivity.

Flexibility is key. We also find something quite interesting in terms of electronic commerce – it enhances supply chain efficiency (performance) but may not make a supply chain mode resilient to labour disruptions. This occurs because labour has to be engaged in additional activities.

Our supply chain network performance measure also allows one to identify the importance of various nodes and links in a supply chain network and to rank their importance. One can then answer such questions as: Which supplier is the most important? Which freight service provider? Which storage facility or distribution centre is the most important and even which demand market?

The book utilises game theory on multiple occasions. What are the advantages of using this method to help us understand the dynamics of the relationship between labour and supply chains?

Game theory helps us to analyse interactions among multiple decision-makers and stakeholders and not just on a single entity such as a firm. Now, as in the height of the pandemic, there is competition in many sectors for labour among firms. These firms can be manufacturers seeking skilled labour; farmers needing labourers for planting and harvesting; freight service providers seeking truckers, and even supermarkets and other retailers needing workers.



needed resources to carry out the various economic activities, such as labour. Game theory can also handle cooperation, as opposed to competition, as in the case of the nonprofit sector, for example. Under limits of resources, such as labour, we seek to determine, in a quantifiable manner, the role of wages in attracting labour and also the impacts on investments in productivity of labour.


Large companies and industry bodies often call for legislation to address labour shortages via the recruitment of migrant labour. Are there any circumstances under which this can end up being ineffective in the long-run due to wages in the sector declining, thereby discouraging domestic labour from working in these sectors?

In the pandemic, as well as now, we are seeing challenges from insufficient labour in various sectors, such as agriculture, in different parts of the world.

Sometimes locals may not wish to engage in difficult farm labour, for example, whether in the US or in the UK, or may even be deployed, as in Israel and Ukraine now. Migrant labour, of the seasonal variety, is then essential to the harvesting of crops.

According [to a study by Oxford University](#), research shows that the impacts of migration on wages and employment prospects for UK-born workers are small." Of course, the impacts may differ depending on the skill sets needed for a particular job. As also noted, therein, "Low-wage workers are more likely to lose out from immigration, while medium and high-paid workers are more likely to gain, but the effects are small."

In my Labour and Supply Chain Networks book, I present a case study on a very interesting agricultural product now grown in the UK – that of truffles, which is perishable and is also a high value product and delicacy. In the Fall of 2021, due to a shortage, a pound of truffles was about \$4,500.

The case study includes domestic labourers as well as migrant ones, being paid the same and different wages. Policy makers need to be  that there may be


The United Kingdom is currently facing wide-ranging labour shortages since leaving the European Single market, as visas are only available for a small number of professions. With regards to the effect of this scenario, the boss of a major logistics recruitment company suggested to me that there will inevitably be cyclical periods of labour supply rising and falling in response to market conditions seeing wages increase and decrease (i.e. wages for truck drivers rise – more people join the profession – the increased labour supply suppresses wages – staff then leave the sector for better-paid professions – the supply of truck drivers declines – truck drivers' wages increase – truckers then take up their old jobs again). To what extent is this hypothesis plausible?

Indeed, now jobs are plentiful in certain countries, whereas the number of available and willing workers to fill them is insufficient. Increasing wages is a powerful tool to attract workers.

At the same time, one needs to consider and to factor in the broader economic scenario. According to [American Progress](#), with the recent inflation, it was found that wages do not need to decline to bring down inflation and that they should not. "Workers need pay raises after decades of stagnation."

The trucking profession is essential and it is not an easy job to have. The pandemic vividly demonstrated the importance of truckers as frontline workers. Trucking is a very tight labour market. Truckers cannot do their jobs from the comfort of their homes. And now, in many parts of their world, sadly, their jobs and routes entail heightened risks. Without transportation and logistics, no products can get delivered and many cannot even be produced since inputs into production processes often also entail transportation. Furthermore, many truckers in the US are retiring and leaving this profession.

Business cycles clearly occur and there are fluctuations in wages as well as in supply of workers. Freight service provision is a critical component of any supply chain network.



wage ceilings, or collective wage agreements negotiated with unions, influence the supply of labour?

There is a lot of evidence that raising wages may increase labour productivity including in manufacturing. This may help to alleviate some of the labour shortages.

Higher wages are also associated with better health and less illness, which enhances worker productivity. Also, we have found that higher wages can have positives on profits of manufacturers. Furthermore, our work shows the benefits for firms who are willing to pay higher wages to their workers in terms of their profits and even lower demand market prices for consumers!

Workers, of course, may be attracted by higher wages for different jobs and may switch accordingly, increasing the supply of labour. It is imperative to have a holistic, system-wide perspective to supply chains in order to be able to quantify issues such as the impacts of increases in wages. Our supply chain network framework allows for such analyses.

How do you foresee automation impacting the dynamics of the relationship between labour and supply chain networks? Are there any circumstances in which a company's automation strategy could have an unexpected effect on its remaining workforce, thereby representing a supply chain risk?

Automation and the wise application of new technologies (such as blockchain and AI) in supply chain networks can reduce cost and enhance efficiency and can also provide workers with new skills and more meaningful work, if proper investments are made.

Given how important it is to retain good employees, companies and organisations must ensure trust. Investments in both technology and labour resources can yield big payoffs.

Supply chains, with increasing automation, may need to be redesigned and that is risky; therefore, workers must be included and proper change management instituted to address potential risks and ensure supply chain

Automation does not necessarily mean layoffs; it does call for a re-imagining and a re-engineering of supply chains with a goal of greater resiliency and performance.

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