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How cognitive tech is influencing the skills of the future

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David Mallon (David) Are the robots coming? And if so, so what? In the 2019 Deloitte Global Human Capital Trends report, a sizable majority of organizations we surveyed told us they expect to grow their use of artificial intelligence and other cognitive technologies, robotics, and robotic process automation over the next three years. As these technologies permeate more aspects of our lives, especially our work lives, many are left to wonder about their effect on work and on the future of work. Our guest today has been studying this topic in great detail. He's Morgan Frank, a postdoctoral associate at MIT's Media Lab. Morgan researches the socioeconomic consequences of technological change and how it influences society and the workforce. We'll talk with Morgan about the relationship between these macro-level labor trends and how they affect micro-level skills and the workplace.

Jim Guszcza (Jim): Well, everybody, welcome to this next episode of the Capital H podcast. This is Jim Guszcza, and we've got a terrific guest today, Morgan Frank from MIT Media Lab. Hello, Morgan.

Morgan Frank (Morgan): Hey, Jim, thanks for having me.

Jim: You bet, we're thrilled to have you. So Morgan, tell us a little bit about your role at the Media Lab and the kind of research you're working on.

Morgan: So I just completed my PhD at MIT Media Lab, where I did research on the future of work through the lens of complex systems and data science. And this is not a very traditional approach when you look at the literature from labor economists

and people, who have traditionally studied technological change and labor, but we're seeing some interesting new results from this perspective. And I will be continuing this research in my new role as a postdoctoral research fellow at the MIT Media Lab.

Jim: This is a huge topic of interest right now. Everybody's talking about artificial intelligence and its impacts on both business and society and on the future of work. Maybe we can start by just defining the terms a little bit. How do you define artificial intelligence? How do you think about it?

Morgan: So this is actually a really good question. It seems that in general, artificial intelligence is this amorphous thing that could include whatever fits your story. For my purposes, I'm thinking about AI as representing the exciting new technological frontiers that are most exciting today. And these are examples where technology is using information and using data as input to perform tasks that were traditionally done by humans.

I wanted to point out that this definition of AI kind of leaves out robotics a little bit, and some people might want to include that in there as well. Let me just also say that for my research, the precise definition of AI ends up mattering only a little bit, and I was a little more interested in the roles that workers' skills play in determining the future of work. So hopefully, our framework for studying the future of work more broadly can adapt and accommodate different types of technology beyond the AI of today.

Jim: Exactly. There's obviously a lot of concerns right now about the impact of artificial intelligence, or maybe call them smart technologies, on the future of work. There's a famous article by Frey and Osborne, that they forecast that north of 45 percent of US jobs are at risk of computerization. There's a *New York Times* article reporting from Davos back in January, and apparently the zeitgeist was that a lot of corporate executives thought that they could replace 80 or 90 percent of their workforce with smart technologies. How do you react to claims like this?

Morgan: In general, I'm much more optimistic than the numbers presented in the Frey and Osborne study, and I think that most people in the future of work research community also think that those numbers are a bit more dire. But also, some of that has been a misinterpretation of those numbers. The misinterpretation is that if a job is, let's say, 20 percent at risk of computerization according to their study, that that might mean that that proportion of employment will disappear for that work. And that's not really what they're saying.

What they're saying is that that proportion of the job, it could be done by computerized methods in the foreseeable future, and it's actually very difficult to say. If you have a certain task that you do today and a piece of technology can do that workplace task tomorrow, it's not clear at all if that's going to produce a deleterious employment effect for you or if it's going to actually make you more productive. So what are the factors that could determine if a worker will be augmented or substituted by a new piece of technology?

Well, that level of detail requires the specific skill sets and the specific workplace activities performed by that worker, and failing to account for this very specific nature of work can produce competing forecasts.

Jim: It sounds like because the data is limited, people can interpret these very broad trends in very different ways.

Morgan: Yeah, I would say in part it's about the data, and it's also about the way we've been studying the future of work. For example, I think most people would expect that when a new piece of robotics is introduced to a factory, that that technology will probably impede on wages or unemployment for human workers in that factory. That seems to be true for a lot of examples, but now let's think about a different example. Let's think about software developers working in Silicon Valley.

A software developer—especially guys doing research in machine learning, let's say their job is kind of to automate themselves. They write code and they write programs that perform tasks that they or a human would otherwise have to do, and yet we're seeing rising wages and rising employment opportunities for those workers. So there's something really different about the way that software developers relate to their technologies that they're interacting with that separates that interaction from the relationship between physical manufacturing workers and robotics. And this idea is well ingrained in the labor econ literature, and it's this idea called skill-biased technological change, which says in general, high-skill cognitive workers are augmented by technology, and low-skill physical workers are substituted by technology.

What are the specific skills that software developers are using? How do those skills relate to other skills that a software developer might leverage in the workplace? And how does the position of the software developer—thought of as this abstract bundle of skills and workplace activities—how does that job's location in the space of jobs separate it from the manufacturing worker, who doesn't seem to be able to adapt?

There's other recent work that shows that actually, the story is not super clear, even when you look at manufacturing. One example of this is, imagine there's this production line, and the production line has station A, which feeds output into station B, and then station B sends out the finished good. And you have workers that work at

station A and a separate set of workers that work at station B, and then you introduce some technology that completely automates station B. Now the question is, what will happen to the workers from station A, and what will happen to the workers from station B?

Well, you don't need the workers at station B anymore because you automated that away, but the value of the workers at station A could go up or could go down. You could imagine that this new technology that's performing station B is so productive that it actually increases the demand for the task performed at station A. And so all of a sudden, there's a bottleneck in your production line. This could lead to increased wages or increased employment for these manufacturing workers working at station A. So this is an idea where there's delayed returns on investment in technology at the firm level.

In this sense, again, if you know your workers' skills, and you know which workers are most easily adapted to the areas of work where you'll need them after the IT investment, then you could proactively be training the workers from station B to instead work at station A.

Jim: Right. So, Morgan, what you're saying seems interesting on a number of levels. One seems to be that we really need that kind of nuanced understanding of people's jobs. Very often, the tasks are kind of interlinked in very complicated ways, and if you don't take into account the nuanced ways in which people work together, when you're introducing a certain technology to either aid or augment a certain skill, you might get a kind of negative impact of technology.

Morgan: Yeah, I have to agree with that, and I think that this production line example kind of highlights that in a really clear way, but it becomes much more muddled and harder to understand where bottlenecks might exist when you consider an executive setting, where a lot more of the interactions between different production stations, if you will, is sort of soft goods or social communication. I've also thought about how policymakers in different cities should be shaping their workforce to prepare for the future of work, and I'm seeing a lot of policy that looks something like, "Oh, you know, autonomous vehicles seems like a real thing; that'll probably suppress employment opportunities for taxi drivers. But it's not a big deal, because employment for software developers is going up, so I will just teach taxi drivers the program and that'll be fine."

Jim: Right.

Morgan: But in truth, the skills required to be a software developer can be sort of far away from the skills that taxi drivers use when they're operating a motor vehicle. And you could be missing a lot of those things. So this is not to say that you can't train these taxi drivers or retrain workers within your company to perform this vastly different task, but it is to say that there could be opportunities that require skills that are nearer to the worker's existing skill set. And in the firm setting, I think that this type of insight can go a long way, especially with changing technology, in the way that companies decide to retrain internally or to hire and onboard new people. And that can be rather costly. In addition to training the new person, you need to also incorporate them into your culture in your company, and that incurs a steep cost.

Jim: That's the theme of some of your other work too, right? You created a tool called Skillscape that analyzes the different tasks that compose jobs, and you're actually able to measure their adjacency, like, you know, for the people who do software development, they also do this numerical reasoning, whereas people who do . . . Taxi drivers, they might have another set of adjacent skills. It seems like that's the sort of underutilized insight that people are taking on board.

Morgan: Yeah, I have to agree. So we were looking at occupational titles in the US, and we were considering the average of each job nationwide when we looked at how important different skills are to each job title and how skills tend to co-occur as important across different job titles. This gives us a way to identify interdependencies between different skill sets, and when we compare many different types of skills, we can construct a map to the whole space of workplace skills that defines US labor nationwide.

I think that this level of insight and this type of tool would be super useful for executives, and managerial staff as well, when they're trying to figure out who they can retrain, how much career mobility are they offering to workers within their company, and how resilient is their staff to changing technologies or changes to the nature of work, so things like offshoring different workplace activities as well.

So if people are interested, they should feel free to see our tool. They can see it by visiting skillscape.mit.edu. And like I said, I think that there's a valuable version of this Skillscape that could be made for each company that could provide some interesting new insights at the firm level as well.

Jim: This is very interesting. What you're suggesting is that companies will have more refined data about the various tasks that comprise workers' jobs in these organizations.

Morgan: Yeah, that's exactly right. I think that having this type of insight for specific firms provides a really valuable tool to management and to executives in that firm who are trying to provide good career guidance to their workers. They will be better able to identify which skills open up the most opportunity for a specific worker, given the skills and abilities that that worker already has. But I think there's also this more systemic value that the company can gain

from this level of insight by understanding how well connected the different roles and the different employment opportunities are within their company.

Jim: We need to kind of take a complex-systems or maybe an ecological approach to thinking about people's jobs. People aren't just doing these tasks in a vacuum, they're doing this as part of this larger network of activities, and there can be subtle aspects of the job that fall between the cracks of the job descriptions. One of my favorite examples, I think, comes from one of your co-authors, is that right? About ATMs?

Morgan: Yeah. This is a great example. Surprisingly, with the advent of automated teller machines, ATMs, at the bank, national employment in the US for bank tellers actually rose proportionally to the adoption of ATMs. This is a sort of counterintuitive result. I think many people would expect that bank tellers are in direct competition with ATMs.

Jim: Right.

Morgan: And the economist at Boston University did a really convincing analysis to try to explain why this occurred. Why was this not a story of technological unemployment? And according to his analysis, there are two features that jumped out. The first is really well understood by labor economists. It's called demand elasticity, and basically, ATMs made it cheaper to open bank branches, and so more bank branches opened nationwide, and this created a demand for more bank tellers to work at all these different bank branches, so that's good.

The second reason I actually found a lot more interesting, and I was really surprised that there wasn't a good model for this type of behavior. Basically, if you consider the role of bank tellers as an abstract bundle of workplace tasks and skills, the skills required to be a bank teller shifted from requiring the numeracy and clerical skills that are needed to handle money and are done by the ATM to instead requiring workers with social and persuasive skills. And this is because the bank tellers of today act more as sales representatives and customer service representatives for bank goods and services.

In this example, to completely understand how ATMs, a new technology, shaped the future of work for bank tellers, you need this equilibrium analysis that incorporates this idea of demand elasticity, but you also need this microscopic model for how the nature of the job in terms of skill requirements fundamentally changed. And there's no good models for this right now, but you can see some other examples of this. For example, if you look at how people advertise their skills trying to get jobs in Silicon Valley as programmers, the specific tools and the specific proficiencies that you advertise change from year to year.

Jim: That's exactly right. And another aspect of that ATM story that I just love is that you talked about the bundle of skills shifting, and they can shift in really qualitatively interesting ways, like going from kind of clerical numeracy skills to sort of social, persuasive skills in the case of bank tellers.

Morgan: I have to agree with you, but I want to point out that, yeah, indeed, social skills seem kind of safe from technological change at the moment. But there are other skills, too. There's a few fringe applications where some machine learning people have developed some algorithms to write academic papers for you, so maybe some of the communication that I have to do in my role as an academic will get automated away, and I'm not so sure if that's good or bad. I guess we'll have to see. But again, it could be an opportunity for the nature of my job to change as a result.

Jim: That's a really good example, Morgan. We're doing something very similar here at Deloitte with our actuaries. Rather than spending a lot of time sort of writing boilerplate reports, we find that we can feed our analyses into software and can write beautiful reports more quickly than a human can.

But it would never replace the . . . It's not just social skills in this case. They couldn't replace the professional judgment needed to do a good actuarial analysis any more than we could replace the good judgment that you, Morgan, or your co-authors would need to think of new research ideas and think about how to use the scientific method to investigate an issue in an interesting way. It'll just kind of change what you do with your time. So it's like you have a smart assistant in this case.

Morgan: Well, I certainly hope you're right.

Jim: Morgan, I'm very intrigued in general about this idea of taking an ecological approach to thinking through the future of work. Can you kind of elaborate on that a little bit?

Morgan: Yeah, sure. So part of my research is to try to understand what leads an economic system—whether that's a whole city or the workers within a company—what leads that economic system to be resilient to changes. And by looking at which species interact with other species in a mutualistic way, you can actually use the density of connections between species, by looking at a map of the connections between species, to accurately predict the health of the ecosystem.

By analogy, maybe we can look at the density of connections between skills that are required by different occupations, and how easily workers can move between different employment opportunities within a city or within a firm, and use the density of connections to say something about the economic resilience of that city or that firm to changes like technological change or offshoring, and just general changes to the status quo of that economic system.

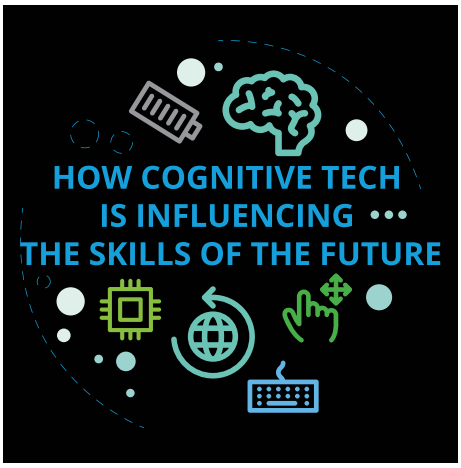
Jim: That's great. And have you found interesting results about how different regions or different cities have more or less economic resilience?

Morgan: Yeah, sure. I would say that it's still kind of early days for this type of reasoning, but what we find is that small cities face greater impact from automation in the foreseeable future, while larger cities seem to be more adaptable and offer more career mobility for the workers within their labor market. We can see this by looking at the skills that are supported in different cities and how densely connected the skill requirements of different employment opportunities are within a city, and then using that to predict things like how automatable are different jobs.

Jim: That's really great. I think that even though the research is early, it'll be . . . That's a useful . . . Just the ecological perspective is an interesting one for both individual people, but also policy planners to keep in mind when they're making their decisions. So Morgan, thank you very much for sharing your research and your insights with us. We'll have to have you back again sometime.

Morgan: Yeah, please. Thank you for having me.

David: The full story about technological advances and their impact to work is, of course, still unfolding. But augmenting workers with technology will, no doubt, lead to work being done in new ways. Thanks to Morgan Frank of MIT's Media Lab for sharing his research and perspectives. And join us next time as we dive into more topics and trends that focus on putting humans at the center of work.



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