THE BROOKINGS INSTITUTION
Brookings Cafeteria Podcast
How automation and AI are redefining work
February 8, 2019

CONTRIBUTORS

FRED DEWS
Host

MARK MURO
Senior Fellow and Policy Director, Metropolitan Policy Program

MOLLY REYNOLDS
Senior Fellow, Governance Studies

(MUSIC)

DEWS: Welcome to The Brookings Cafeteria; the podcast about ideas and the experts who have them. I'm Fred Dews. Will robots take your job? Will automation send thousands of workers to the unemployment line? How will automation change the way we live and work? These questions have been asked about labor and the economy for decades, and with more urgency now as artificial intelligence continues to become more persuasive in our lives. But the answers—according to my guest today—are more complex and the story is more nuanced.

Mark Muro, Senior Fellow in the Metropolitan Policy Program, is co-author with Robert Maxim and Jacob Whiton of a new report titled "Automation and Artificial Intelligence: How Machines Are Affecting People and Places." Mark and his co-authors write that, "while the robots are coming, they will bring neither an apocalypse nor utopia but, instead, both benefits and stress alike."

Also, on today's show, in her review of what's happening in Congress, Senior Fellow Molly Reynolds looks beyond the government shutdown dramas to explain House and Senate hearings on a wide variety of issues.

You can follow The Brookings Podcast network on Twitter @policypodcasts to get the latest information about all of our shows, including Dollar & Sense: The Brookings Trade Podcast; Intersections; and 5 on 45. Find them on our website, on Apple Podcasts, or wherever you like to get podcasts.

And now, on with the interview. Mark, welcome back to The Brookings Cafeteria.

MURO: Hey, great, thanks, Fred.

DEWS: I looked at the calendar and it was July 2016 when you were in the booth

and we had a conversation about your report on fracking.

MURO: Well, we haven't been automated out of our jobs, either of us.

DEWS: I'm glad to hear that. So, let us continue then because robots are not going to take our jobs. But it's a fascinating report—automation and artificial intelligence, how machines are affecting people and places—what did you and your co-authors find kind of at the broadest level?

MURO: Yeah, right off, good to jump right in. We have found that in aggregate over time—in the next decade or 15 years—that we will see a broadly manageable change in technology that will affect virtually everybody to some extent, but for most people, it won't be the end of the world. It'll be broadly manageable, and, especially, if you have a bachelor's degree, you're probably going to do okay in the coming phase.

With that said, we do see significant segmentation under that of how different job groups, occupational groups, different places and different social groups will be affected; and—surprise, surprise—the underrepresented groups will be especially vulnerable.

So, one takeaway is most of us are going to do okay, but those who are vulnerable in other respects may be vulnerable to inroads from new technologies.

DEWS: I want to dive into those details in a few minutes because I think they're the heart of the report and one of the most fascinating aspects of the research that you do because it does touch on everyone's lives. But, first, let's talk about kind of at the high level, what's the methodology of this research? How do you get the data? What's your kind of level of analysis here?

MURO: Yeah. Well, we are utilizing what's called the task framework. We have

built an analysis out of particular statistical evaluations of 800-plus actual jobs and projections for how they will be affected by these technologies. The probabilities of replacement of tasks by technologies—robots, automation of various forms, artificial intelligence—were provided to us by McKinsey Global Institute, with whom we've worked on advanced industries and other topics. Taking those probabilities, which range from almost zero to 100 percent for different jobs—basically occupations, we then were able to build that out into looking at the effects on occupational groups, effects on industries, effects on places, and then effects on individual underrepresented groups. Everything is built out of the share of the tasks that might be displaced. That's not necessarily a percentage of joblessness, right; it's just about change. And I would say, ultimately, our measure is essentially about stress in the workplace, likely change over time, and potential disruption. So, it's not necessarily measurement of joblessness or job disappearance.

DEWS: And it's also a national view, but it's by metropolitan areas, hence, the Metropolitan Policy Program. So, you're looking at jobs and occupations within metropolitan areas, right?

MURO: Yeah. Well, we provide broad national analysis, but we do think that, all of that, all of those big economic effects are built out of specific impacts on particular occupations, particular places, and, yes, particular demographic groups. So, we're trying to get down under the aggregate storyline, and we've been gratified at the interest that people in real places are feeling and responding to the report because I think that, I think this is one of those silent topics that is diffused in workplaces, over the dinner table, this is the kind of thing people are talking about, and they're concerned about it.

4

DEWS: And I'm sure that people who have picked up this report, people who are listening to this podcast have gone to your appendices and looked for their state. You have automation potential by each U.S. state, and also automation potential in the top 100 metros, and so on, lots of great data in this report, lots of ways for people to really interact with it and find themselves kind of in this report. We'll get to some of those other issues around education, demographics, and so on.

MURO: And to that, for people listening at home, you can go online and look up your state, look up your metropolitan area. We have a cool animation, so you can get the top line worry figures for your region and your job.

DEWS: Okay, cool. Well, that would be at brookings.edu/metro, and people can search for it. Let's talk about some of the terminology. You have automation, you have artificial intelligence. Can you talk about what those terms mean? Are they the same, are they different?

MURO: Okay. So, there's certainly been automation for thousands of years and hundreds of years, and in the Industrial Revolution, you know, textile making is a form of automation. And, really, automation is the substitution of work activities undertaken by humans that can be undertaken also by machines. So, that's the fundamental transaction we're talking about.

We have focused on what we call the period of digital automation that we date, roughly, to 1980—the onset of the personal computer, you know, and then the Internet, and increased processing speed, and the whole takeoff that we've also written about in our work on the digitalization of everything. So, we call of the digitally empowered, labor saving, and work accelerating technologies automation. Some of those are robots, you

know, in the physical world, and those were the ones that had the most evident earliest impact, right, as they swept into factories and clearly were tied to the so-called hollowing out of middle skill jobs in the factory world and the shift of more workers into lower skilled work. So, robots are part of it.

Software is part of it. Windows is an automatic technology, in our view, but then so are the next technologies coming: Artificial intelligence; software systems that make decisions in a way through statistics and other processes in a way that humans do, and will be particularly powerful—we think this is just the takeoff period for AI—and broadly, historically we see, looking backwards, a period dominated by robots and the PC is now giving way to, I think, a period where we're going to see all that but plus much more in terms of these artificial intelligence.

DEWS: In this period of the past few decades dominated by robots and the PC, what did you find is the impact of that kind of automation on jobs?

MURO: Yeah, and that's a great question. One point we want to make here is that, in fact, we're already living with the period of automation. Automation is all around us. Everything we're doing is in some way automated now. But, again, that first extremely visible impact has been that of industrial robots in the factory—classically, you know, in the period say from 1970—we can say that period is kind of moved to about now. But what we saw was, you know, very strong substitution in the middle of the job description. This has been tracked by the MIT professor, David Autor, who shared data with us and whose work we sort of replicated in some ways to connect the onset of automation with the replacement of what are called routine, or codifiable, or rote rule space work—very much what was happening in factories in the 1970s, 1980s,

and that hollowing out of the labor distribution replacement by these robots. And then we see a final employment impact in which people are displaced from middle skilled jobs, middle paying jobs, and wind up making do with lower skill service jobs which were not being automated historically in the past.

So, better jobs were more suitable for automation in the last period, and, I think, that's because middle skill jobs were led to higher pay, the cost of automation in the last 25 years only made sense to replace those jobs. Now, we're looking forward into a different calculus. So, we've seen this hollowing out, this shift into lower-end work for many, many people. That was the first effect—not entirely a happy one.

On the other hand, it was not a job apocalypse. In fact, we created 54 to 60 million jobs in the last period, and, actually, slightly increased the ratio of jobs to workers in the first automation period. So, it's a mixed record.

DEWS: Let me make sure I understand this term hollowing out, because I think it's used with some precision here. It's that given the entire distribution of jobs and wage percentiles by occupations, it's those jobs in the middle—not the lowest paying jobs, not the highest paying jobs—those in the middle that are kind of being scooped out of the labor force by automation, and that's the hollowing out.

MURO: Yeah. The hollowing out was the replacement, often by robot-driven assembly line work of fairly well-paid middle skill workers who were doing things that were pretty well compensated but were rule space, were rote, you know, were probably sort of boring jobs. And, actually, a boring job is a clue to danger in the automation period. You know, and this was the classic, you know, crisis of American industrial activity; and I can say it also involved in some way some kinds of middle skill office work

as well.

You know, as the computer comes along, and we begin to, you know, automate HR activities; basic business administration—those things became vulnerable too— also, decent middle skill jobs. So, that's what we mean by the middle; and that's what came under pressure in the first automation era.

DEWS: So, now, looking ahead into the automation era in which we now find ourselves, what kinds of occupations will be the most affected? Are we still looking at jobs in the middle, or now we have to focus more on the lower wage jobs or even the higher wage jobs?

MURO: Yeah, what's extremely interesting is we're depending on, you know, what we think are mostly very credible assessments by McKinsey & Company and their consultation with experts with various modelling activities and so on. We're now seeing we have a different curve before us. The future shape of the curve suggests that there will be more pressure at the bottom of the scale, the education and the skill scale. You know, the better one's education levels and the more complicated one's job, by and large, the better more protected or more resilient the job is.

Now this is disconcerting because we've just said that in the last 25 years we hollowed out the middle and shifted a lot of people down the curve—you know, a lot of people did very well, and a lot of people wound up in that lower skill zone. Well, now, the projection is for substantially more pressure on those lower down doing more routine kind of service activities, including, you know, jobs in food and drink, eating accommodations, hotels, you know, concierge work, and then, again, more of these office and administrative activities as well. So, those are now coming under pressure.

So, it's a different curve. It goes farther down. Part of it is that the technologies are now cheaper, so it makes sense to automate potentially more job descriptions, but it's a very different look, and it has the kind of effect of now putting people who have been sort of protected in not great jobs but protected from automation now coming under pressure.

DEWS: Talk about how that correlates with educational attainment.

MURO: Yeah, one of the strongest findings here is that the more education you have the less vulnerable you are, and, clearly, those who have a bachelor's degree are significantly more protected than those who lack a bachelor's degree, and it goes down from there.

You know, this is, I think, because the kind of task mix of higher skilled jobs is more complicated; involves more judgment; maybe more creativity, all of those things are guards against automation. The better one's education, the more complex one's skills mix, the better one is able to withstand these technologies because the less chance there is that machines could replicate that activity.

DEWS: I'm looking at one of your tables in the paper—and I encourage listeners to go to the report and look at these tables too because they're full of fascinating data. And the way I read it is—this is Table 1, on page 30—the occupation, payroll and timekeeping clerks—average wage $44,000—automation potential, 87 percent, typical education required less than a bachelor's degree. Food preparation workers, as you just mentioned,91 percent automation potential, packaging and filling machine operations and tenders, 100 percent automation potential. When you talk about automation potential what exactly does that number mean?

MURO: So, again, that doesn't mean that they're 100 percent certain to lose their

job, but it means that 100 percent of the tasks within their job, within their day's work could be replaced, could be carried out by automation using technology available now. That's what's a little chilling here, right, but you get the point, so, at the other end of the scale you get, you know, a very different list of places. So, all of those are sub-bachelorette jobs. Important because they're assessable to people, but they're turning out to look vulnerable in this analysis.

DEWS: One other fascinating thing that jumps out about this is that a lower education occupation that is less vulnerable to automation is something like home health aides.

MURO: Yeah, and, you know, I think, a home health aide's job isn't well paid, but it's complex, it is delivering services, including of comfort and support, and a lot of judgment in often difficult conditions likely will be around a while. So, some of these jobs are not celebrated by society, but will be with us for a long time, and I think they provide an opportunity for us to know some jobs are going to be around and to make them better. But that's a great observation that there are sub-bachelorette, non-BA jobs that will be around.

(MUSIC)

DEWS: We'll go back to the interview with Mark Muro in just a moment but, first, here is Senior Fellow, Molly Reynolds with what's happening in Congress.

REYNOLDS: I'm Molly Reynolds, a Senior Fellow in Governance Studies at The Brookings Institution. With the 35-day partial government shutdown behind them and little apparent appetite for a repeat performance when the current temporary funding bill runs out on February 15th, Congress has gotten down to work in the 116th Congress. A

quick look at some of the hearings held so far in the House and Senate give us some useful insight about how both chambers are likely to be spending their time over the next two years.

In the House, we've seen two hearings—one by the House Oversight and Reform Committee and one by the House Judiciary Committee on HR 1. Titled the "For the People Act," the bill is a wide-ranging package that seeks to expand access to voting, require states to use independent redistricting commissions for drawing congressional district lines, makes a number of changes for campaign finance system, and implements ethics reforms, including requiring the president and vice president to disclose 10 years of his or her tax returns.

The measure is unlikely to be signed into law. Majority Leader Mitch McConnell, whose support would be needed to bring it up in the Senate, has called it a "power grab" by Democrats. The fact that it's House Democrats first major bill and carries the HR 1 number is important.

The first 10-billed numbers in each Congress, HR 1 through HR 10, are reserved for priorities of the Speaker of the House, so, any topic addressed by one is a credible signal that the policy area is important to the party.

We've also seen a number of other hearings in the House that reflect the degree to which Democrats care about particular issues. The House Judiciary Committee drew a sizeable crowd for its first hearing on gun violence in eight years. In addition, the House Natural Resources Committee met for a hearing on climate change. Both of these issues are of importance to key Democratic Party constituencies, so it makes sense that they would be among the first priorities for the House to focus on with

Democrats now controlling the chamber.

There's been much discussion about House Democrat's plans to engage in aggressive oversight of the Executive Branch in the 116th Congress. That work has begun and, indeed, in the coming days and weeks, we will see hearings on issues like the family separation crisis, and with the administration witnesses, like Acting Attorney General, Matt Whitaker.

But the target of one of House Democrat's first major oversight pushes is not the Trump administration, but pharmaceutical companies. The House Committee on Oversight and Reform launched an investigation of why and how drug prices have increased significantly, holding a hearing with stakeholders in January, and sending letters to 12 pharmaceutical companies seeking information about their pricing practices.

While much of the House's oversight focus is likely to be on the Executive Branch, this emphasis on oversight outside the federal government, and in a policy area where there is at least some bipartisan interested action, is an important reminder that oversight can be a valuable tool in addressing broader policy problems.

Because of the switch in party control, the House has been the focus of much of the attention in the opening weeks of the 116th Congress, but the Senate hasn't been asleep at the wheel.

The Senate Finance Committee held its own hearing on drug pricing in January and has also invited seven major pharmaceutical companies to testify at the February session. We also saw the Senate Judiciary Committee hold a confirmation hearing on the nomination of Bob Barr to serve as Attorney General, and the Environment and

Public Works Committee hold a similar session on the nomination of Andrew Wheeler to head the Environmental Protection Agency. Two more cabinet-level positions—the Secretaries of Interior and Defense—remain open, so more confirmation hearings are ahead.

The Senate is also likely to continue to spend significant time this year processing judicial nominations. Nominations, after all, do not require the same 60 votes to end debate that most other Senate business needs, making them an attractive way for Republicans of the chamber to spend their time, especially now that Democrats control the House.

Indeed, Republicans have been discussing a change to Senate procedures that would reduce the amount of time allowed for debate on some nominations with the hopes of speeding up the process even further. Especially in a period of divide the control of Congress, when legislating is comparatively more difficult than under unified party control, hearings are an important tool in each majority party's toolbox. If your party has a majority on the committee, after all, you can set the hearing agenda without cooperation from the minority party.

With House Democrats ramping up their promised efforts to investigate the Executive Branch, hearings will be an important area to watch to figure out what's happening in Congress.

(MUSIC)

DEWS: Let's talk about the geographic variations in automation risk, you have between states, and you have between metro areas, and you have rural areas versus metro areas. Can you talk about the geographic variations?

MURO: Right. Remember the general approach here is to work from the occupational mix of places and to get from that to impacts. Well, places that are not particularly well educated, places that have a lot of people doing automatable kind of rule spaced work are going to be vulnerable. So, you get a few basic takeaways. There's no doubt that the industrial heartland with its manufacturing history, and now large concentrations of people in also low-end service work, is exposed.

So, an entire region of the country has an elevated exposure. That's the heartland. Within that, smaller cities are more exposed than bigger cities, and that is in part because it tracks with their variations of education levels. And then rural America with relatively low education and concentration in activities that are replicable, are rules based, is also highly exposed. So, again, some of the places that are already struggling are going to be confronted with new headwinds, we think.

DEWS: You have another really fascinating table in the report—Table 4, page 42—that lists the top 15 and the bottom 5 metro areas by educational attainment, but then also their share of jobs in occupations with high automation exposure. So, Washington, D.C., where we are right now has the highest percentage of people with a BA or higher and it has a 17.7. I think the lowest share of jobs in occupations with high automation exposure as compared to say, or contrasted with, a place in Florida, Lakeland, Winter Haven, Florida, 20 percent of adults with a BA or higher, 28.9 percent share of jobs in occupations with high automation exposure.

MURO: And this is only the list of the largest 100 metros. This goes up to numbers like 55 percent or so in some industrial cities in, for instance, Indiana. Among the larger cities, the variation is still significant, but it's muted compared to how far it

14

goes when you bring in smaller communities. So, again, smaller communities already

struggling economically in the country and are going to need to contend with further

replacement of work.

DEWS: And what about automation's potential, or automation's risk, based on

demographic issues, demographic characteristics like gender, age, race and ethnicity.

MURO: Yeah, one thing that we hadn't really thought through and made sense

when we found it was very high elevation of exposure for those young workers—say, 16

to age 24—and much of this exposed by their heavy reliance on food service jobs. But

the exposure of food service now to kind of Panera-style, kiosk ordering, or McDonald's

type-in ordering, is really going to change one of the mainstays of first jobs. I think we're

concerned about that because we're talking about often vulnerable populations, but also

the first work experience of many people. So, I think that's an exposure.

The other thing is concern here about underrepresented groups—Latinos,

especially African Americans, Native Americans—that have significantly elevated

exposure as groups often driven by low educational attainment, but also given, I think,

affected by, mainstage job orientation in different groups.

In this case, African Americans somewhat benefit from their high representation

in some of the caring and home health jobs, which, again, hard jobs to raise a family on,

but also durable ones, and for that reason they are somewhat protected compared to

Latinos. But it is, I think, troubling that this plays out across vulnerable populations as

well.

DEWS: What about variation by gender?

MURO: Men are slightly more vulnerable, and you can imagine why—oriented

towards the factory. A lot of men in production jobs, still. Trucking is an area that will come under pressure, and then construction jobs. But, I think, it is interesting men are likely going to need to migrate into some of the more helping job categories, and there's interesting literature that they just have not wanted to take those, but that may be one thing that's needed. But this is not a massive gap, it's a couple of points, and it's real.

DEWS: I do want to ask you about some of your policy recommendations in a moment, but I want to ask one more question kind of about where we are now. The analysis is based on trends in what you can know about the economy today and, reasonably, perhaps infer in the near future. Are there potential major changes that could alter the analysis and change these baseline trends in some more risky or disruptive way?

MURO: This is a great point. I will revise your question into just impacts either positive or negative, or that could exacerbate the trends or that could mitigate them somewhat.

A couple of things—first, how well the economy does is going to matter. It seems like when the economy rolls along, then we see new technologies. That isn't quite what we see. The literature actually shows that when the economy struggles and when businesses are having trouble with their bottom line is when they accelerate automation. So, large shares of labor displacement in the business cycle occur in the first year or two of a business, of a downturn. So, the more time we spend with a sluggish economy, we may see more automation, not less. So, I think that's a significant somewhat disconcerting way to think about this.

So, it is good that we've had a long, durable recovery, right, since 2010, and that

has probably slowed the deployment of automation. All bets are off after the next downturn. So that's one.

Faster or slower tech development, I think the suspicion is that some of these technologies are moving along faster, maybe then projected. We've heard some slower—CEO of Waymo, two weeks ago, suggested that he didn't think we would see full automation of vehicle transportation in bad weather. So, maybe some technology is moving along slower, some may be moving along faster, but the speed of technology development and the speed of cost reduction will have a lot of effect here.

And then the other one is policy. We're humans. We can shape the deployment of these technologies. So, maybe, maybe a future Congress will decide that it wants to slow the deployment of these technologies. I'm not sure that would be an advisable approach, but who knows what will happen. But I think there are significant factors that could either speed this up or slow it down. A general comment is that the faster this occurs, the harder it will be to adjust to.

DEWS: So then, considering that, what are the policy responses that you look at? What are the strategies for responding to, and evolving with, this change?

MURO: Right; and I think co-evolution is the right way to think about this. This is about transitions, this is about change over time, getting better at moving through change. The first action is sort of implied by what we were just saying about economic performance. To the extent that the economy is generating a lot of jobs, this will be easier, right. They'll be more jobs, more opportunity, more ability for people to move around. So, I think our first thought is that giving more of a tip in federal reserve discussions towards running a full employment economy, that's part of why this decade

is allowed more people to move around, stay employed, become employed. So, all of this will be easier if there is plentiful job creation.

But there's no doubt we see a few broad societal and individual, and institutional needs. You know, one is viewing education and training as an ongoing constant activity rather than a one-time investment. You know, I think the model now is you get educated, you learn your life-long skill and you're set. That's not what it's going to be. It's going to be constant evolutions. We call it stressing a constant learning mindset, and from that that's a change in how families, and individuals, and students view their lives. But it will be a change in how companies, educational institutions, and labor market organizations think about—we need to get much better at not just education, but re-education—skills and re-skilling. So, there's going to be a lot of change and we're all going to have to get more used to it, but also, looking at facilitating adjustment, helping people move from one thing to another.

I mean it's one thing to expect that change, it's another thing to engage in programs, engage in training opportunities that allow you to do that, or support you to do that. We don't do that very well as a country. We're going to have to get better at it. And then we're going to need to mitigate actual hardship. Some people aren't going to do well with these transitions. I believe I'm fundamentally optimistic that most people will manage, but some won't; in part because some of these trends are going to be difficult for some of the people who are already vulnerable. For those, we need to support displaced workers a little more. Help them retrain, subsidize hiring. We may need subsidized jobs for workers, and the same goes for hard hit places. You know, this mapping suggest this isn't going to be the same everywhere, and, especially, smaller,

heartland communities are going to be up against it, and for them, I think, we need to help them transition their economies in ways that will lead towards greater numbers of more durable jobs and we may need to support these communities, and so on. So, a variety of things, but it's mostly about assuming change and trying to mitigate impacts for those who are struggling.

DEWS: So, Mark, at the end of the day, it's clear that automation has been and is kind of a natural part of economic and social development. I mean, obviously, AI is new, but, on balance, should people embrace what's happening, should they fear it a little bit, or adopt some other stance, maybe in between?

MURO: These technologies are tied to core digital technologies that have delivered a lot of wealth and a lot of good, but they're ambiguous, and we certainly can't just assume the best. I think people should be broadly confident that we can master these trends, but we need to be sure that we are asking the right questions and not deferring entirely to the pathway of technology, right.

You know, I think that people, and organizations, and thought leaders need to be asking more questions, and certainly understanding these technologies so we can make the best of them, and there may be ways we need to shape them to make sure they are working for us and allowing us to work with them, right. So, I think, it's a challenging proposition. I do think in the next decade, I think most people will be okay, but, I think, complacency would be a problem and people need to be very alert to this.

Now, I'm somewhat encouraged. I hear in releasing the report, we've had a lot of response, especially in regions where reporters or local leaders are asking a lot of interesting questions, and very curious, and very probing in their questions about what

this means for them, and I think that bodes well.

DEWS: Well, Mark, it's a fascinating and important analysis. Thank you for coming on the program to discuss it today.

MURO: Absolutely, Fred. Thank you for asking all the right questions.

DEWS: You can learn more about the report by Mark Muro, Robert Maxim, and Jacob Whiton, "Automation and Artificial Intelligence: How Machines are Affecting People and Places"—on our website, brookings.edu.

(MUSIC)

The Brookings Cafeteria Podcast is the product of an amazing team of colleagues, including audio engineer and producer, Gaston Reboredo, with assistance from Mark Hoelscher. The producers are Chris McKenna and Brennan Hoban. Bill Finan, Director of The Brookings Institution Press, does the book interviews, and Jessica Pavone and Eric Abalahin provide design and web support. Our intern this semester is Quinn Lukas. Finally, my thanks to Camilo Ramirez and Emily Horne for their guidance and support.

The Brookings Cafeteria is brought to you by The Brookings Podcast Network which also produces Dollar & Sense, The Brookings Trade Podcast; Intersections, 5 on 45, and our Events Podcasts.

Email your questions or comments to me at bcp@brookings.edu.

If you have a question for a scholar, include an audio file and I'll play it and the answer on the air.

Follow us on Twitter @policypodcasts.

You can listen to The Brookings Cafeteria in all the usual places.

Visit us online at brookings.edu.

Until next time, I'm Fred Dews.