May 7, 2018

(Via online at www.regulations.gov)

Docket Operations Facility
U. S. Department of Transportation
1200 New Jersey Avenue, SE, W12–140
Washington, DC 20590

Re: Docket No. FRA–2018–0027

Comments of the
American Train Dispatchers Association (ATDA)
Brotherhood of Locomotive Engineers and Trainmen (BLET/IBT)
Brotherhood of Railroad Signalmen (BRS)
Brotherhood Railway Carmen Division TCU/IAM
Sheet Metal, Air, Rail and Transportation (SMART)

Dear Docket Clerk:

The Labor Organizations identified above are the recognized collective bargaining representatives of a significant majority of railroad industry workers engaged in train operations under the Railway Labor Act, as amended, for the class or craft of locomotive engineers and trainmen employed by Class I railroads and nearly all passenger and commuter railroads, as well as operating employees on Class II and Class III carriers. For the reasons set forth below, the labor organizations respectfully thank the Federal Railroad Administration ("FRA") for inviting comment on the safety sensitive topic of automating the railroad industry.

FRA seeks comment on

> "the future of automation in the railroad industry-the extent to which they believe railroad operations can (and should) be automated-potential benefits, costs, risks and challenges to achieving such automation and how the agency can best support the railroad industry's development an implementation of new and emerging technologies in automation that will lead to continuous safety improvements and increased efficiencies in rail operations."

See Fed. Reg. Vol. 83, No. 56 12646.

FRA has posed many questions regarding automation of the industry that reflect a very positive view of something that has not been proven to be effective in terms or safety or efficiency. This is not to say that automation cannot have positive attributes for safety, but only that FRA and industry stakeholders should view automation and its effects in light of how safe the automation has proven to be over time.

The Labor Organizations realize many of the questions the FRA has asked can only be answered by the rail carriers themselves. Nevertheless, we assert a broad reservation of rights to respond to the answers the carriers provide, and specifically reserve the right to request that the comment deadline be extended should the carriers file their comments near the deadline.

As the FRA considers the future of rail automation it must not forget its mandate from Congress, "[i]n carrying out its duties, the Administration shall consider the assignment and maintenance of safety as the highest priority, recognizing the clear intent, encouragement, and dedication of Congress to the furtherance of the <u>highest degree of safety in railroad transportation</u>. 49 U.S.C. § 103(c)(emphasis added). As such, safety must be first and foremost when discussing the future of automation of our nation's railroads. It would be unethical and would violate the mandate of Congress to sacrifice safety for potential profits.

Safety must be the highest priority when considering the introduction of autonomous rail operations in the United States. In considering issues of automation in the American rail system, it is important to examine: (1) the essential job functions performed by humans that cannot be replaced by automation, (2) automation in other countries and distinguishing characteristics between those nations and the United States, and (3) the ever-present threat of hostile actors looking to inflict mayhem on our nation's railroads.

The core issues are how the agency defines automation and the systems to which it refers. A robust discussion or debate cannot exist without defining the terms of the debate, so the Labor Organizations below attempt to provide a framework for discussion concerning how FRA appears to define automation and identify its scope. This is necessary in order to delineate costs and benefits, risks analysis, challenges and safety improvements. Automation and its interaction with people in the locomotive cab and elsewhere is a broad topic to which much human factors expertise has been devoted. The concepts identified below are not intended to be exclusive.

<u>Dictionary:</u>

The dictionary definition provides a very wide scope definition that is informative, but maybe not that useful for regulatory means or for the industry:

> au·to·ma·tion (noun)
> au·to·ma·tion [ˌɔːtəˈmeiʃn](au·to·ma·tions)
>
> 1. Replacement of human workers by technology

Railroad workers have a long history of adapting to new technology, interacting with it and benefiting from it. Workers who work in the cab of a locomotive, Locomotive Engineers and Conductors, do not have an adverse relationship with the different forms of automation that have been deployed in the past—when they function as intended or make rote tasks easier or less distracting. Within the automation discussion is a human factors puzzle that never ends as long as the industry keeps introducing new forms of machinery, software or hardware. Train crews work with and adapt to all three.

Human Factors and Non-Human Factors That Act Like Human Factors

How does a software engineer program a computer to sort out all the negative behaviors of a human and replicate only the good? If a machine is supposed to be superior and perform in a superior way how does it do so if it relies on human frailties for its design, manufacture and deployment? How does it learn to "reason" with its surroundings when circumstances change—will that be beneficial to the bottom line when the default machine decision is to "keep going" when it should "Stop" or vice-versa. How long can a company sustain this type of real world scenario snafu? Software mistakes or sloppy code that performs in perplexing ways has the potential of causing accidents or only bringing a railroad to a standstill.

Many human factors issues must be examined by FRA that go much deeper than the RFI has requested. Items in need of study are those such as machine vision in railroad operations, vigilance problems and decrements when human machine interface issues arise. Also, when and how does crew complacency occur as more automation is introduced into the cab of a locomotive? There exists a Catch-22 involving automation reliability.

With increased automation reliability comes an increase in system trust. When operators trust a system more due to its reliability, complacency rises. The better the product the higher the potential for complacency. According to Dekker, complacency refers to an incorrect strategy that leads to suboptimal monitoring. Important signals may be missed because of operator complacency, because they have too great a trust in their systems doing the right thing. Such trust tends to grow in the operation of increasingly reliable systems (Billings 1997).[1]

There needs to be an adoption framework for regulating that is based on verifiability that builds trust in any system before it is deployed full scale. How will FRA ensure the agency has staff with the expertise within to enforce or make regulations and or approve the deployment of automation? Will automation be used to fix automation errors? What level of stakeholder buy in or industry consensus will be needed for what forms of automation? Who will be the risk-susceptible populations of people who will work in on and around automated vehicles or machines and how will they be identified? Our concern here is that FRA avoid the trap that if you simply remove the human from the equation (via automation or technology) then you remove the problem.

Caution and Potential Complications With Automation

Automation is a child of science and industry loves science. Science is responsible for most of the many advances of human progress. Science, however, is not perfect and should not be

[1] Dekker, Sidney. Safety Differently: Human Factors for a New Era, Second Edition (Page 199). CRC Press. Kindle Edition.

considered to be. That said, science is reliable because the scientific method is consistently tested, and Every so often the scientific method fails.

The Labor Organizations believe in science-based measures that improve the safety for its members and the public. For example, we have long advocated the use of cutting edge science to end the problem of fatigue in the industry. The industry, on the other hand, has struggled with science in this area. When it comes to fatigue there apparently has not been enough science or data (despite sufficient availability) to satisfy the industry's appetite for "more." As such, railroads cannot be trusted to self-regulate themselves when it comes to the implementation of this technology, as a race to eliminate all paid positions for the sake of profit could lead to catastrophic results.

With regard to fatigue, the Labor Organizations understand the science has been done and the math has been calculated. Sleep deprivation is a real problem with a simple solution; regular sleep that is uninterrupted and in harmony with circadian rhythms. The industry has similarly struggled with the science of stopping trains or preventing collisions when human judgment breaks down or humans become incapacitated. Positive Train Control and its antecedents have been claimed to be either too complicated or too expensive for railroads since the NTSB first recommended them in 1967.

But before we give everything over to science, sometimes we have to ask whether or not a proven technology is actually a good idea to deploy in certain situations. Kurt Vonnegut reminds us of how human infatuation with science can be devastating:[2]

> "I thought scientists were going to find out exactly how everything worked, and then make it work better. I fully expected that by the time I was twenty-one, some scientist, maybe my brother, would have taken a color photograph of God Almighty—and sold it to Popular Mechanics magazine. Scientific truth was going to make us so happy and comfortable. What actually happened when I was twenty-one was that we dropped scientific truth on Hiroshima."

Change in the railroad industry usually comes at a slow pace. There is not going to be a Day Zero before which rail operations humans performed that and after which all of those same tasks will be automated. Railroad workers have been interacting with forms of automation since the beginning of the railroad industry in the mid-19th Century. Automation and its attendant technology are not new, but rather are presented to the railroad worker in different and occasionally new forms. Sometimes the form is simply a different way of using an old technology. Drones, for example, are seen as high tech, however the technology that makes drones fly is old. Remotely controlling a model airplane also is old technology. It is the deployment of a flying model airplane (or helicopter – rebranded as a quad copter with a camera mounted on it and global positioning systems) that makes people think they are encountering a "new technology."

[2] 1970 Address to Graduating Class at Bennington College, accessed at http://jsomers.net/vonnegut-1970-commencement.html.

According to Duke University professor and former Navy F-18 Hornet Pilot Mary Cummings automation is nothing new in aviation. She says, "Commercial Airliners have been flying themselves for 30 years. Pilots on average only touch the yoke or stick 3-7 minutes of an entire flight."

At Duke, Professor Cummings has developed the SRKE Taxonomy, which stands for: Skills, Rules, Knowledge and Expertise. About these terms she explains, sensors are good at performing some tasks. Automation is very good at performing rules-based tasks where the same procedures are almost always applied. This is what she terms skill-based reasoning — person or computer learning to keep plane balanced in flight. Computers do this pretty well and also handle rule-based reasoning — following procedures pretty well. Cummings compares this to a cookbook; automation does this very well.

However, when knowledge-based reasoning is required, it is because there are higher levels of reasoning needed when there are not clear rules or procedures because the environment is not what you thought it might be or subject to sudden, unanticipated change. Things become suddenly unpredictable. The programmed inputs and outputs do not recognize the contingency.

Cummings sites the good example of Chesley "Sully" Sullenberger's handling of the emergency ditch landing of US Airways Flight 1549 on January 15, 2009 in the Hudson River in New York City, which has been termed the "Miracle on Hudson" because every passenger survived. This was no miracle. This was a skilled pilot who knew what to do on a specific aircraft with specific capabilities in a very specific situation where many variables intersected in time and space. Sully said this about that day and his application of experience in the harrowing situation:

> "One way of looking at this might be that for 42 years, I've been making small, regular deposits in this bank of experience, education and training. And on January 15, the balance was sufficient so that I could make a very large withdrawal."[3]

And this is in one of the most automated industries there is today. It is hard to imagine the fate of the passengers of Flight 1549 if automation would have been tasked with landing the plane without the benefit of Sully's higher form of reasoning.

In fact, a person encountering a specific machine for the first time does not make it technology. In the case of drones or machine vision, only the circumstance in which those components have been made at a price low enough to allow them to be merged onto an object is new. So machines like cameras on remote controlled aircraft will certainly be a new encounter for rail employees. Since their deployment for operational and infrastructure testing has not been used before, regulators will have to confront their use and whether or not they can be used safely in an environment in which they were not designed to operate.

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[3] Newcott, Bill (May–June 2009). "Wisdom of the Elders". *AARP Magazine*. 347:52.

<u>The Desire to Automate</u>

Automation is continually sought as a possible solution to what we know as Reason's Swiss Cheese Model. In Reason's Model accidents occur when the holes in the Swiss cheese line up to let the error through. However, there are more recent thoughts on that idea. New thinking is emerging about the holes in Reason's Swiss Cheese Model. Sidney Dekker, Erik Hollnagel and Paul Difford are three of the leading authorities in this advance beyond Reason.

An accident causation specialist, Difford finds fault in Reason's Swiss Cheese model — the idea of the organizational accident and multiple causation — preferring to think that an accident has only one cause. He believes that trying to address "multiple causes" is over-controlling, under-effective and unlikely to promote safety in the future. Therefore, Difford argues, behavior-based safety is a relic of the 1980s.

Difford believes that Hollnagel overlooks the fact that many safety problems are simple. "Hollnagel argues that one of the reasons we need to change is that the problems have become more complex as society and technology are more complex. If you apply that to air traffic control and trains then I agree – we have to deal with greater complexity than 50 years ago. But if we're talking about a laborer in a trench, it's not any more complex. It would be unfortunate to throw the baby out with the bathwater," he says.[4]

Again regarding how to define the topic, Dekker notes:[5]

> The idea is that automation can be introduced as a straightforward substitution of machines for people—preserving the basic system while improving some of its output measures (lower workload, better economy, fewer errors, higher accuracy, etc.). Indeed, Parasuraman et al. (2000) recently defined automation in this sense: "Automation refers to the full or partial replacement of a function previously carried out by the human operator" (p. 287). But automation is more than replacement (although perhaps automation is about replacement from the perspective of the engineer). The interesting issues from a human performance standpoint emerge after such replacement has taken place.

Dekker also says:

- The idea that we can replace human work by automation without any consequences (other than greater safety or efficiency) is based on Tayloristic assumptions about decomposing work into components that can be divided up between human and machine. This is also known as the substitution myth.

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[4] https://www.healthandsafetyatwork.com/safety-theory/new-thinkers

[5] Dekker, Sidney. Safety Differently: Human Factors for a New Era, Second Edition (Page 209). CRC Press. Kindle Edition.

- Automation, or any new technology, changes the tasks that it is designed to support or replace. It creates new human work, new pathways to success and failure, and new capabilities and complexities.

- Data overload is a generic human performance problem that often attracts automation. Depending on how the problem is framed, however, automation and new technology can help or hinder the human capacity to manage anomalies in their monitored process.

- New technology is not the manipulation of a single variable in an otherwise stable system. New technology instead triggers transformations in human and social practices, and human adaptation of, and to, the new technology.

- Envisioning practice recognizes that future is not given, that humans and technology coevolve and that new capabilities and complexities can emerge. By building or imagining envisioned worlds, designers can explore the reverberations of technology change before committing resources to fixing particular solutions.[6]

MABA-MABA Lists

Dekker also explains the use of Machines Are Better At – Men Are Better At ("MABA–MABA") lists, which were developed to try to develop a Tayloristic taxonomy of those things machines are better at and those things that humans are better at; the problem is that such lists rely on linear based presumptions of fixed human and machine strengths and weaknesses. Another technology-based metric is that there are four (4) stages of information processing — acquisition, analysis, selection and response — that provide guiding values to which functions should be kept or discarded. This also assumes a linear input and output model. In other words, MABA–MABA relies on inputs and outputs to be static. In a static railroad world, a piece of test track could have a curve that is rated for speeds up to 30 miles per hour and a train that always travels at 40 miles per hour could be slowed to 30 miles per hour. As soon as those conditions change, however, a 4-stage processing model is no longer operational, nor is a MABA-MABA list.[7]

Changes in the Industry Brought on by Automation or Technological Changes

Radios replaced cabooses, and the workers who inhabited them were either laid off or moved to the cab of the controlling locomotive. Remote controlled locomotives replaced locomotive engineers in switching operations, cameras are taking the place of visual inspections on site. Clerical workers have been reduced in the industry as jobs have been eliminated via technology.

New technology does not always mean automated and it is important to make distinctions when and where they exist. Automation does not always mean fully autonomous operation, which why FRA needs to provide clear definitions when it reduces the real world adoption of

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[6] IBID, (Page 208).

[7] IBID, (Page 209).

automation to written regulations. FRA's power to define cannot be overstated in any instance, but when dealing with automation the agency must take care to understand what is being explained and defined, as do all the stakeholders in the industry, in this complex arena.

Due to complexity and expense, laws and culture, major changes in the rail industry have always evolved over a period of time. Most times new forms of machinery need to be regulated so that a standard can be developed. This is difficult. Getting railroads to agree on a standard is also not a speedy process and many times there is no process in which to get the parties together to discuss standards. Whether or not the SAE or the UITP taxonomy (83 Fed. Reg. at 12647) should be applied to railroads is just one area where discussions are required, in order to examine the relevance of that taxonomy to current and planned operations.

We also believe there is no appetite on the part of the public, regulators, employees or railroads to have a fully automated system. This introduces cultural, business, employment and safety issues that are too large to simply turn on a switch and go automated (if that were even an option that was feasible or affordable). To even imagine this, one must imagine a linear system where everything humans do is directly replicated by machines without the introduction of so many new problems that an actual new system is created.

The railroads may be trying to convince FRA that while attempting to try to rid themselves of the human error of a locomotive engineer, they are perfectly amenable to inserting into the system human error of the software engineer. They have also shown a desire through their past actions to inject new technology into the existing rail system because they can and there is no regulation to stop them because the inventions are coming faster than regulators can contemplate a potential safety implication. Rail carriers may be trying to move to a time when assignment in the cab is transformed from someone who proactively operates a train into someone who is more of a systems monitor. All such efforts pose huge safety and cultural problems, as we address in more detail below.

<u>Questions Posed by FRA</u>

Although FRA seeks comments and relevant information and data on all issues related to the development and continued implementation of automated train systems and technologies and potentially fully autonomous train operations, FRA specifically requests comment and data in response to the following questions:

General Questions

1. *To what extent do railroads plan to automate operations? Do railroads plan to implement fully autonomous rail vehicles (i.e., vehicles capable of sensing their environments and operating without human input)? If so, for what types of operations?*

The Labor Organizations reserve the right to respond to this question after having had reasonable time to review and consider comments submitted by and on behalf of railroad carriers.

2. *How do commenters envision the path to wide-scale development and implementation of autonomous rail operations (or operations increasingly reliant on automated train*

systems or technologies)? What is the potential timeframe for technology prototype availability for testing and for deployment of such technologies?

If the past is prologue, wide-scale development of automation would come slowly and in small increments. As far as the timeframe, the Labor Organizations would defer to the rail carriers for any potential time tables they might have for putting a prototype into testing, and we reserve the right to further respond to this question after having had reasonable time to review and consider comments submitted by and on behalf of railroad carriers.

3. *As discussed above, the railroad industry is currently taking steps in developing standards for automation. How does the railroad industry currently define "autonomous operations"? Would it be helpful to develop automated rail taxonomy; a system of standards to clarify and define different levels of automation in trains, as currently exists for on-road vehicles and rail transit? What, if any, efforts are already under way to develop such rail automation taxonomy? Should FRA embrace any existing and defined levels of automation in the railroad industry or other transportation modes such as highways or public transit? For example, should FRA consider SAE Standard J3016_201609 (see* http://standards.sae.org/j3016_201609/*), which provides for six GoA for on-road vehicles, or the four GoA for public transit fixed guideway vehicles?*

This question assumes the railroad industry has already developed standards and has defined "autonomous operations." If so, they did not develop these standards with FRA or FRA would not need to inquire regarding the definition. Another important question is how FRA would define "autonomous operations," and whether or not it would simply adopt the carriers' language.

As previously noted, the RFI identifies a pair of potentially applicable taxonomies. We believe the UITP would be insufficient for railroad operations on modern freight and passenger rail due to the complexity of operations. Also, the taxonomy says nothing of the systems that would be in effect and how they would account for different levels of cognition of train crews who operate in a variety of different circumstances. It is entirely mechanistic. Listing the entirety of train operations as starting and stopping and door opening and closing does not begin to describe the levels of tasks automation would need to perform to achieve viability. The cited SAE taxonomy is, in our view, even less relevant because it addresses surface motor vehicle operations, which is a step further away from U.S. railroad operations than the UITP's treatment of streetcars and trolleys.

In 2009 FRA issued its Final Report in the agency's Task Analysis for Locomotive Engineers, which studied human factors and the implications of technology. FRA did the same for Freight Conductors in 2012 and Passenger Conductors in 2013. When discussing PTC, FRA stated that

> "Train crews must avoid too much reliance on the new train control technologies. In particular, it is important to continue to run the trains without the PTC system activated. Therefore, if the system ever fails, the engineer will still be able to operate the train

safely."[8]

The report also identified key cognitive functions that served as the cornerstone for locomotive engineer performance, including: broad awareness that develops an accurate current situation model of the immediate environment (including location, activities and intentions of other agents in the vicinity such as trains and roadway workers); the need to generate expectations and think ahead so to know where and how to focus attention, prepare for anticipated actions as well as plan for contingencies; the need to actively engage in sustained visual and auditory monitoring including radio communication; and the need to manage multiple demands on attention; the need to prioritize and manage multiple goals and rapid decision-making response to unanticipated changes in conditions (weather, missing signs, and unplanned events).[9]

Unplanned events and the ever changing nature of events that unfold in real-time during a train's trip from beginning to end cannot be overstressed. Automation does well performing tasks that happen the same way over and over. It does not do so well — as Professor Cummings pointed out — with higher level reasoning. Surprises? The typical railroad trip is fraught with them. In 2013, various U.S. Class 1 railroads and the Oliver Wyman Firm identified that there were over half a million unexpected events on U.S. Class 1 freight railroads alone. This accounts for 1 in every 4 trains, and excludes incidents caused by track and signal failures.[10] This is a compelling safety reason for at least two qualified persons to be in the cab of every freight locomotive.

4. *What limitations and/or risks (e.g., practical, economic, safety, or other) are already known or anticipated in implementing these types of technologies? How should the railroad industry anticipate addressing these limitations and/or risks, and what efforts are currently underway to address them? Are any mitigating efforts expected in the future and what is the timeline for such efforts?*

The Labor Organizations reserve the right to respond to this question after having had reasonable time to review and consider comments submitted by and on behalf of railroad carriers.

5. *What benefits and efficiencies (e.g., practical, economic, safety, or other) do commenters anticipate that railroads will be able to achieve by implementing these technologies?*

Again, the Labor Organizations reserve the right to respond to this question after having had reasonable time to review and consider comments submitted by and on behalf of railroad carriers particularly because there is no way we can anticipate any rail carrier's forecast for gains or losses in business resulting from implementing technologies. That being said, we would add that all pre-automation benefits to safety that have been gained would have to be reexamined to conclude whether or not those safety gains will be traded off for the profitability of automation.

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[8] U.S. Department of Transportation-Federal Railroad Administration, Technology Implications of a Cognitive Task Analysis for Locomotive Engineers, ix, 2009.

[9] IBID, vii, viii.

[10] Oliver Wyman Presentation, see attachment.

6. *What societal benefits if any, could be expected to result from the adoption of these technologies (e.g., environmental, or noise reduction)? What societal disadvantages could occur?*

We firmly believe that any societal benefit that may occur from automation of railroad operations will be dwarfed by the societal disadvantages. Each of our Labor Organizations dates back to the 19th Century, one of us to the early 1860s. As a result, we share a rich, and oftentimes tragic, history in dealing with revolutionary changes in production and transportation. It must be acknowledged that the discussion of the subject raised in FRA's RFI does not arise — and cannot take place — in a vacuum. To the contrary, media reporting on automation, robotization, artificial intelligence, and the shift in retail sales from so-called "brick-and-mortar" to online shopping has become ubiquitous over the past several years. The prospects for driverless motor vehicles, drone-delivered packages to residences, and robot-prepared fast food are just a few of the "technological marvels of the future" bandied about recently. Indeed, we fully expect that the railroad carriers will justify their automation plans, at least in part, on a claimed need to be able to compete with driverless over-the-road trucks.

Consequently, when considering societal effects, the appropriate question is not "What societal disadvantages could occur as a result of autonomous operations on America's railroads?". The real question is "What short-term and long-term societal disadvantages are likely to occur as a result of autonomous operations displacing human workers in as much of the economy as Wall Street is willing to underwrite?"

In this regard, we are reminded of the November 1954 UAW-CIO conference report, published in January of 1955, regarding then-United Auto Workers President Walter Reuther's recent tour of the Ford Motor plant in Cleveland. A company official pointed out some new automatically controlled machines and asked Reuther "How are you going to collect union dues from these guys?" Reuther replied, "How are you going to get them to buy Fords?"[11]

The *Harvard Business Review* reported, on October 24, 2017, that "[s]ince the early 1970s, the hourly inflation-adjusted wages received by the typical worker have barely risen, growing only 0.2% per year."[12] Moreover, "labor's share of income … has fallen from nearly 65% in the mid-1970s to below 57% in 2017." *Id.* And, according to the Employee Benefit Research Institute, the percentage of private-sector workers participating in an employment-based defined benefit retirement plan plummeted from 28% in 1979 to just 2% in 2014.[13] During this same period, however, increases in productivity far outstripped increases in worker compensation:[14]

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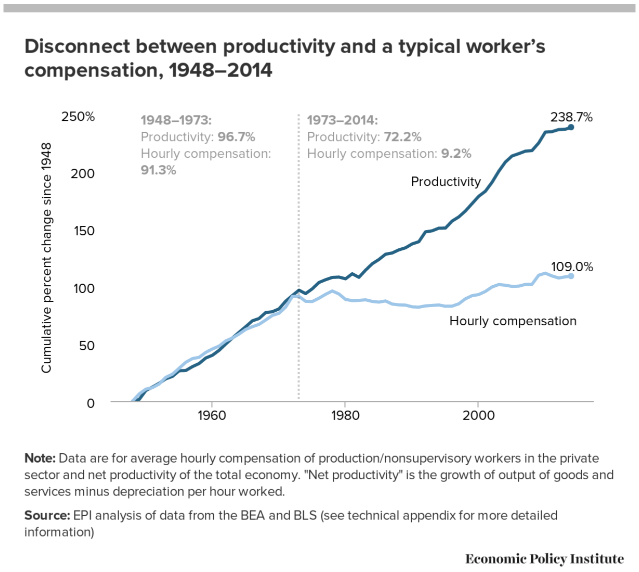
[11] *See* https://uaw.org/walter-reuther-quote-collection/.

[12] *See* https://hbr.org/2017/10/why-wages-arent-growing-in-america.

[13] *See* https://www.ebri.org/publications/benfaq/index.cfm?fa=retfaq14.

[14] *See* https://www.epi.org/publication/understanding-the-historic-divergence-between-productivity-and-a-typical-workers-pay-why-it-matters-and-why-its-real/.



There are numerous reasons for the above 45-year trend. One of the most prominent is a technology-driven shift from a manufacturing-based economy to, first, a service-based economy and, more recently, an increasingly finance-based economy. Another is a series of trade agreements that have created a conveyor belt on which jobs are shipped from America and all variety of consumer goods and foods are shipped into America. Yet a third is a fundamental shift in corporate management philosophy from long-term steady growth to maximizing short-term profitability.

Economist William R. Emmons of the Federal Reserve Bank of St. Louis predicted, in 2012, that continuing stagnant incomes was a major trend suggesting that consumer spending would grow more slowly than in recent decades.[15] U.S. housing starts in March stood at less than 53% of the historic high in January of 1972, and at approximately 57% of the most recent high, in approximately 2007.[16] And, except for the 3-year period following the 2008 recession, U.S. car sales in 2017 were lower than any year since 1961, and only 55% of the peak in annual car sales, which was reached in 1973.[17]

To be certain, automating a significant sector of the American economy will exacerbate the above trends, because incomes from that sector are likely to decline precipitously; no one could seriously suggest that any company or industry would invest in large-scale automation without expecting a significant financial return. Furthermore, automating a high-wage sector or industry — as the railroad industry — would produce at outsized effect on the national economy. Indeed, the railroad industry should expect to suffer a decline in traffic each time another chunk of

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15 *See* https://www.stlouisfed.org/publications/regional-economist/january-2012/dont-expect-consumer-spending-to-be-the-engine-of-economic-growth-it-once-was.

16 *See* https://tradingeconomics.com/united-states/housing-starts.

17 *See* https://www.statista.com/statistics/199974/us-car-sales-since-1951/.

disposable income disappears because, to paraphrase UAW President Reuther, robots and computers don't actually buy any of the goods that railroads ship.

The economic trends that have been endured by this society during the last two generations has already severely stressed the social compact that has safeguarded our nation for 85 years. The development of the so-called "gig" economy — which is nothing more than a 21st Century term for permanent temporary employees — already restricts significant portions of the working population from employment-based health care coverage and retirement benefits. For railroad workers, significant automation would threaten the solvency, and the very existence, of the Railroad Retirement system.

In today's political climate, the automation of a significant portion of the railroad industry will immediately contribute to an intensification of all of the above negative economic trends, with no thought to alleviating measures. Automation of other sectors will produce a cascading effect, to the detriment of the nation and its society.

Our archives are replete with the documented history of the barely civilized conditions endured by the majority of Americans during the last three decades of the 19th Century and the first three decades of the 20th Century. This was a time when even skilled workers could not earn sufficient wages to feed, clothe and house their families. It was a period marked by massive technological change solely in the interest of corporate profitability, often implemented at the point of a bayonet or the business end of a truncheon. It is a history that no right-minded American should want to re-live. Yet that is precisely the danger that could ensue when the scope of legitimate discussions regarding technology implementation is unreasonably narrowed.

The Labor Organizations reserve the right to further respond to this question after having had reasonable time to review and consider comments submitted by and on behalf of railroad carriers.

7. *What, if anything, is needed from other railroad industry participants (e.g., rail equipment and infrastructure suppliers, manufacturers, maintainers) to support railroads' automation efforts?*

This is best answered by rail carriers and vendors, but we reserve the right to respond to this question after having had reasonable time to review and consider comments submitted.

8. *How does the state of automation of U.S. railroad operations compare to that of railroads in other countries? What can be learned from automation employed or under development in other countries? What are the unique characteristics of U.S. railroad operations and/or infrastructure as compared to railroads in other countries that may affect the wide-scale automation of railroad operations in this country?*

As FRA notes, "the only known fully-autonomous freight railroad system is in Australia," where it operates as part of the Australia Rio Tinto mining company and began fully-autonomous train operations on an approximately 62-mile stretch of track in Western Australia." 83 Fed. Reg. at 13584. That operation is barely seven months old, having been announced on October 2, 2017. *See* Exhibit XXX. Not mentioned in the Rio Tinto press release is the fact that the train carried empty cars only.[18] Moreover, the Australian Department of Primary Industries and Regional Development reports[19] that the climate in the Pilbara region of Western Australia — where the Rio Tinto train operates — is classified as "hot desert in northern and inland areas and hot grasslands in the north-west" with the following temperature ranges:

- During summer and early autumn (December to March), average daily temperatures exceed 30°C/86°F across the region, with average daily maxima exceeding 35°C/95°F from October to March;
- In northern inland areas, such as Marble Bar, average maxima exceed 40°C/104°F during summer and temperatures exceeding 45°C/113°F are common; and
- During the winter months (June to August), average temperatures are around 20°C/68°F across the region.

The climate in the sole area where fully autonomous train operations occur — and for a shorter distance than the traditional American railroad operating division — is so different from the vast majority of climates in the U.S. that the Rio Tinto operation provides no reliable data by which theoretical fully autonomous train operations in this nation can be analyzed.

The Labor Organizations reserve the right to further respond to this question after having had reasonable time to review and consider comments submitted by and on behalf of railroad carriers.

Trains in the United States are significantly longer than in countries where limited automated operations exist. Many U.S. trains stretch far more than two miles long, with some over three miles in length. This creates a number of complications that are not present in other countries. For example, most railroad crossings in the United States are "at grade," meaning they are at street level. Therefore, vehicles are struck at a high rate, resulting in thousands of collisions and over 200 deaths per year.[20] Since roads are commonly built on section lines that are one mile apart, and trains are usually longer than one-mile, blocked crossings result in limited access by emergency crews in the event of a collision. Without a conductor to pull the pin to separate rail cars at the crossing and an engineer to move the train, access to accident accidents are significantly impeded, resulting in a delay of life-saving care.

Additionally, trains frequently derail or strike automobiles in already difficult to access areas. Care would be further delayed if a second employee had to be transported to the site in order to conduct the above-described functions in the event of an accident. Any autonomous operations would need to account for these deficiencies, and the additional strain such operations

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[18] *See* http://www.afr.com/business/bhps-reverse-track-on-rio-robot-trains-20171015-gz19iq

[19] *See* https://www.agric.wa.gov.au/climate-change/climate-pilbara-region-western-australia

[20] https://oli.org/about-us/news/collisions-casulties

will put on local emergency personnel, resulting in preventable loss of life due to delayed response times at accidents.

In addition to issues presented above, the excessive length of American trains results in significantly heavier trains than seen in other countries with limited autonomous operations. As a result, trains suffer more equipment failures and break-in-twos that cannot be properly be addressed by an autonomous operation. Humans are needed on the scene to address these and other mechanical failures that require immediate action to potentially avert disaster

Safety and/or Security Issues

9. *How do commenters believe these technologies could increase rail safety?*

Humans Play an Essential Rule in Thwarting Hostile Actors

Railroads are also subject to dangers that go beyond the standard safety issues such as derailments and collisions. Dangers like terrorist attacks and cyber-attacks continue to loom, as trains are a prime target for hostile actors due to the potential colossal damage that can be inflicted by compromising their operation. Humans have the ability to perceive threats and take action in a manner that autonomous operations cannot. Where there is the possibility of out-of-control trains carrying thousands of tons of hazardous materials, it is critical that discussions regarding train automation address these concerns in a substantial way, or the threat to life and property would be significant.

Terrorism is an Ever-Present Threat to Railroads

Unfortunately, trains are prime targets for terrorists or other hostile actors seeking to inflict massive damage to both life and property. News reports are rife with reports of both successful and unsuccessful attacks on rail systems. The role of human engineers and conductors in such incidents simply cannot be replaced by an automated system. For example, in October of 2017, an individual with allegedly terroristic goals attempted to take control of an Amtrak train and pulled the emergency brakes.[21] There, the train's conductors helped to physically subdue the perpetrator before any loss of life occurred.

In the 2015 Thalys Train Attack, a man wielding an AK-47 opened fire on a crowded train.[22]

While the perpetrator was famously halted by passengers onboard, witnesses stated that the acts of the conductor were heroic as well.[23]

[21] http://time.com/5089950/taylor-michael-wilson-supremacist-amtrak/

[22] https://www.theguardian.com/world/2015/aug/21/amsterdam-paris-train-gunman-france

[23] http://www.lefigaro.fr/cinema/2015/08/24/03002-20150824ARTFIG00083-thalys-jean-hugues-anglade-nuance-ses-propos.php

While these are stark examples, they clearly show that a human presence can mean the difference between life and death when terrorists try to take lives. Unfortunately, this is the world we live in, and when the development of autonomous rail systems is considered, such stories need to remain at the forefront of our thinking.

Cyber-Attacks are a Growing Threat to Railroads

In addition to traditional terror attacks, cyber threats grow more prominent every day. The response of automated systems would be severely limited in such events. An automated rail system would be a prime target for a cyber-attack, as present events have made clear. For example, recently, the San Francisco Municipal Transportation Agency was subjected to a ransom-ware attack where hackers took control of a number of devices and demanded a ransom in return.[24]

While the hackers did not take control of any rail operations, the attack was a stark wake-up regarding potential new avenues of disruption and danger through attacks on railroad computer systems. All systems that use a computer network are susceptible to hacking, but in an autonomous rail operation, the results could become catastrophic. In the event hackers are able to take control of a fully autonomous hazardous material train, no human would be present to manually intervene to stop a cataclysmic event. With the increasing frequency and severity of reports regarding computer hacking, we think any serious consideration of this technology is at the least premature until such threats can be addressed and foolproof preventative measures can be taken to ensure the safety of both railroad employees and the general public.

If automation is envisioned as an augmentation to performance rather than a replacement for personnel, it may increase levels of safety. Changes in modes is an important aspect of answering this question. Mode changes are a key part of automation. They should be predictable, and humans who interact or interface with computers or other automated devices need proper notification when a mode change occurs by automation — or when an operator triggers a mode change — so that the trigger does not set into motion a chain of events not recognizable to the operator.

New systems also require a certification process. Studies on mode awareness in aviation have shown that there can be a significant gap between data availability and data observability that are dependent not only on the physical and temporal features of any display, but also of the interests, goals and attentional direction of the observer (Woods and Hollnagel). Dekker notes that work-as-imagined is not the same as work-as-done. He further points out that the question is not who has control and to what extent, but rather how do we work together? Dekker calls this the notion of the team player.

Another concern involves data overload and warning systems. Data need to be deployed to aid

[24] https://www.sfmta.com/blog/update-sfmta-ransomware-attack

human problem solving without causing interruptions, distractions or arriving in data storms that overload a person's ability to understand the data to make a proper decision or perform a certain task. It also should be considered that data failures in one system can affect other systems. This is critical when considering the modern locomotive cab environment, in which there are multiple technology systems and multiple crewmembers.

Current aircraft systems have become very sophisticated and have been through many changes to be refined and become more useful. Dekker identifies one major thing that aircraft systems are not good at spotting when there are automated warning alarms given to a crew is: Is this a trend and will this get worse?" (217). In other words, data needs to be interpreted to be useful, because purely raw data can distract its audience.

Another problem with automation is that each railroad will want its own system or choose not to have the same level of automation on their tracks; we see this currently with PTC, which has experienced significant interoperability issues. Similarly, latency is a significant concern. Systems do not always process information at the same time or synchronously. There also is decision lag time from the crew once information has been provided and interpreted before a task is performed.

Dekker view the above problems as contributing to Data Overload, creating concerns regarding (1) how data interact with warning systems, (2) data overload as a problem of meaning, and (3) data overload as clutter problem (e.g., too much data on the display screen). The risk from data overload is that, rather than

riding a system of human error, automation will merely change the types of error experienced. In this regard, Dekker poses the following questions

1. Can human error be automated out of a system?

2. What is Tayloristic about function allocation methods that divide tasks up between human and machine? What is the substitution myth? Do you have examples from your own world where automation changed the tasks it was supposed to support or replace?

3. What are different ways to characterize data overload, and which differing assumptions do these characterizations make about the nature of human cognition?

4. Complexity is more about relationships than components. Can you think of an example from your own world (like the obstetric one in this chapter) where the introduction of new technology demonstrably changed the relationships between people (and people and the technology)?

5. If the future is not "given," is safety certification of complex systems possible at all? How can we still say meaningful things about future systems without overextending our epistemological reach?

6. How can data overload be characterized? Which characterization is suited best for capturing the complexities of the introduction of technologies to help humans manage data overload?

7. If design concepts are hypotheses about what might be useful in the collaboration between humans and machines, then how can the underspecification of early design ideas help? Why could it actually hamper progress on usability and safety if design concepts are fixed early on?[25]

The Labor Organizations reserve the right to further respond to this question after having had reasonable time to review and consider comments submitted by and on behalf of railroad carriers.

10. *What processes do railroads have in place to identify potential safety and/or security, including cybersecurity, risks arising during the adoption of these technologies and that may result from the adoption of such technologies?*

The Labor Organizations reserve the right to respond to this question after having had reasonable time to review and consider comments submitted by and on behalf of railroad carriers.

11. *How should railroads plan to ensure identified safety and/or security risks are adequately addressed during the development and implementation of these new technologies? What is an acceptable level of risk in this context?*

It is important to acknowledge that "acceptable level of risk," is subjective, and depends upon who is assuming the risk and what kind of risk is discussed. At the very least, automation technology involves financial risks, productivity risks, and safety risks. No action —or, for that matter, inaction — is risk free, so there must be acceptance of risk in everyday life; however, adding safety risks associated with automation so the carriers can enjoy less financial risk is not an acceptable outcome. The Labor Organizations reserve the right to further respond to this question after having had reasonable time to review and consider comments submitted by and on behalf of railroad carriers.

12. *How should railroads plan to ensure the integration of these technologies will not adversely affect, and will instead improve, the safety and/or security of railroad operations?*

It is difficult to predict how the railroads will propose to accomplish ensuring the safety of these complex systems. It also is far from certain whether the public will simply accept that everything is all right with robot trains. Drones, driverless cars, social media and bank account hacks are forcing Americans to rethink a number of the conveniences that they have been enticed to use, because of the increasing risk of having their personal data stolen, putting their safety at risk and compromising their credit. Dr. Cummings warned of passive hacking of machine visions by simple changes to roadside speed and stop signs; in one case it turned a stop sign into

[25] Dekker, Sidney. Safety Differently: Human Factors for a New Era, Second Edition (Page 234). CRC Press. Kindle Edition.

a 45 mph sign with a few pieces of black tape.[26] While that specific hack may not seem directly relevant to the railroad industry, it can affect worker and public view of the security of autonomous systems generally. The Labor Organizations reserve the right to further respond to this question after having had reasonable time to review and consider comments submitted by and on behalf of railroad carriers.

13. *What are the safety and security issues raised by automation in railroad operations at public and private at-grade highway-rail crossings? To what extent should DOT coordinate with state or local governmental entities on certain safety or security issues? How might automation improve the safety of the general public at highway-rail grade crossings or along the railroad rights-of way?*

On March 18, 2018 a pedestrian was struck and killed by an autonomous motor vehicle in Tempe, Arizona. The car was operated by Uber and had an emergency back-up driver (system monitor) at the wheel. While we certainly know the outcome in terms of human life, it is difficult to speculate the ancillary safety issues that will result when a fully autonomous train strikes a vehicle or pedestrian at a grade crossing. Who will help if there is no train crew? Will the lag time produced by not having a crew onsite be responsible for more deaths? Does time after a car or person is struck become critical or is time not relevant to accident victims? Common sense dictates that time is critical in such a situation; however, some will no doubt argue that, since no data exist on these questions, FRA should simply leave them alone. This is precisely the trap the agency must avoid. The Labor Organizations reserve the right to further respond to this question after having had reasonable time to review and consider comments submitted by and on behalf of railroad carriers.

14. *How do railroads plan to ensure safety and security from cyber risks?*

The Labor Organizations reserve the right to respond to this question after having had reasonable time to review and consider comments submitted by and on behalf of railroad carriers.

15. *How do the safety and/or security, including cyber risks, faced by U.S. railroads implementing these technologies compare to the risks faced by railroads operating in other countries? How have railroads in other countries addressed or mitigated these risks? Are there opportunities for cross-border collaboration to address such risks?*

The Labor Organizations reserve the right to respond to this question after having had reasonable time to review and consider comments submitted by and on behalf of railroad carriers.

[26] Lecture, "Autonomous Vehicles on the Road: Implications for Safety and Innovation," Professor Missy Cummings, Duke University, hosted at Cannon Office Building 122, Washington, DC, April 4, 2018.

Infrastructure

16. *What are the infrastructure needs for effectively, safely, and securely implementing these technologies? FRA is particularly interested in wayside, communication, onboard, operating personnel, testing, maintenance, certification, and data infrastructure needs, as well as any other expected or anticipated infrastructure needs.*

The Labor Organizations reserve the right to respond to this question after having had reasonable time to review and consider comments submitted by and on behalf of railroad carriers.

17. *How can the nation's existing rail infrastructure be leveraged to support the implementation of new infrastructure, necessary for the adoption of automated and autonomous operations?*

The Labor Organizations reserve the right to respond to this question after having had reasonable time to review and consider comments submitted by and on behalf of railroad carriers.

Workforce Viability

18. *What is the potential impact of the adoption of these technologies on the existing railroad industry workforce?*

Technology has not been particularly kind when examining the workforce by the numbers in the past. Whether or not those numbers are predictive regarding the future cannot be stated with certainty. Some groups of railroad workers have adapted to new technology and used it, albeit with fewer numbers; others — most notably telegraphers, who once were themselves on the cutting technological edge — were simply displaced by it. However, the ranks of railroad employees have shrunk dramatically over the last 6+ decades. More recently, this has not been due to automation or technology alone, but also as a function of consolidation of rail lines and carrier mergers. From 1980 to 2005 this was pronounced. For example, in 1980, Class I railroads owned 270,623 miles (mi) of track and employed 458,000. In 2005, they owned 164,291 mi of track and employed 162,000, a one-third reduction in track miles and a nearly two-thirds reduction in the workforce over the 25-year period.[27]

The automation of train operations has the potential to cause the loss of tens of thousands of good paying union jobs across America. The potential for the dislocation of workers in the event automated rail operations become common practice is extreme. The effect of technology on the workforce has already been seen, as remote-control operations in railroad yards have led to substantial job losses of locomotive engineers and yard switchmen.

Automation is having a substantial impact on the craft of yardmaster as well. Unfettered train automation would affect significantly more employees and make the communities in which trains travel through far more vulnerable to all sorts of potential hazards. Add to this the potential

[27] U.S. DOT Federal Railroad Administration, An Examination of Employee Recruitment and Retention in the U.S. Railroad Industry. Final Report, August 2007 Pg. 18.

automation in transit and the trucking industry and we will have a vast loss of opportunity for people without college degrees to secure a job that pays a decent wage, further increasing income inequality in our country.

The above being said, the general desire to automate is as old as work itself. It is the old notion of Taylorism — Frederick Taylor's so-called "scientific management" that transforms the subjective into the objective. The specific desire to automate in the railroad industry at this time is still coming into focus. So far there has not been a clear articulation of industry goals because technology itself keeps changing rapidly, while rail operations and industries must keep moving day in and out. There cannot be major interruptions of service to do real world testing on automation technology that proves to be unreliable.

FRA and the industry have partnered to have a test track at the Transportation Technology Center Incorporated ("TTCI") in Pueblo, Colorado to address this issue. It is not readily clear or articulated that TTCI has a desire to automate that would override their current mission of making the current system safer. There is a transition cost that has not been expressed.

Automation and Taylorism go hand in hand and in the rail industry with regard to railroad operations it has manifested itself to this point in more of an integration model rather than a replacement model. In this way, it is possible automation can help train crews rather than merely replace them, but it remains to be seen how many railroads hold this viewpoint. The Labor Organizations reserve the right to further respond to this question after having had reasonable time to review and consider comments submitted by and on behalf of railroad carriers.

19. *Would the continued implementation of these technologies, including fully autonomous rail vehicles, create new jobs and/or eliminate the need for existing jobs in the railroad industry?*

It has been said that labor unions are against automation because it could take their jobs. It is true labor unions want to protect their member jobs and livelihoods and have always believed that to be the driving part of our mission. The ability to work hard and earn a paycheck is part of the bedrock of American values. Advocates of automation are simply making the other side of the argument, that being the faster automation is achieved the faster profits can be realized from not having to compensate a person to do a job and that machines and automatons do not call in sick. Indeed, once upon a time in this Nation, unions were considered the organized voice of labor and corporations as the organized voice of capital; two sides of the very same coin. As President Lincoln observed in his First Annual Message to Congress:

> "Labor is prior to, and independent of, capital. Capital is the fruit of labor and could never had existed if labor had not first existed. Labor is the superior of capital, and deserves much the higher consideration."

Most people cannot afford to lose their jobs and their families depend on income, so they want to keep their jobs. However, the Labor Organizations' mission on behalf of their members should not, and cannot, call into question the validity of our cautionary stance regarding safety risks associated with automation. The public's and our own as our members are the ones who have the most personal, physical exposure to danger when an accident occurs. Discounting our safety concerns because we fight to preserve jobs and earnings is the most extreme form of double standard, given the profit-seeking goal of the industry underlying its support of automation it may advocate. The Labor Organizations reserve the right to further respond to this question after having had reasonable time to review and consider comments submitted by and on behalf of railroad carriers.

20. *What railroad employee training needs would likely result from the adoption of these technologies? For example, if the technology fails en route, will an onboard employee be trained to take over operation of the vehicle manually or be required to repair the technology en route?*

The Labor Organizations reserve the right to respond to this question after having had reasonable time to review and consider comments submitted by and on behalf of railroad carriers.

Legal/Regulatory Issues

21. *What potential legal issues are raised by the development and implementation of autonomous train systems and technologies within the industry?*

It is difficult to encapsulate all of potential legal issues that will be raised by the public or employees who are injured or killed if full automation occurs. It would not seem responsible or efficient in terms of safety to allow a train to operate in the public with no crew to control it. We also anticipate that

FRA would be tasked with rewriting vast portions of 49 CFR Parts 200-299 as well as other regulations that rules that are connected to those sections. The Labor Organizations reserve the right to further respond to this question after having had reasonable time to review and consider comments submitted by and on behalf of railroad carriers.

22. *What are the regulatory challenges (rail-specific or DOT-wide) that must be addressed before autonomous rail vehicles can be made a part of railroad operations in the United States?*

Again, we believe FRA would be tasked with rewriting vast portions of 49 CFR Parts 200-299 as well as other regulations that rules that are connected to those sections. For example, in 2016 FRA published a Proposed Rule regarding train crew staffing. 81 Fed. Reg. 13918 (Mar. 15, 2016). FRA identified many regulatory provisions that were explicitly or implicitly designed for a multiple-person crew. FRA warned that the following current regulations would not work as intended with one crewmember:

1. Providing point protection for shoving or pushing movements (49 Code of Federal Regulations § 218.99(b)(3)(i)); switches to the normal position and loss of job briefings (49 C.F.R. §§ 218.103 through 218.107);
2. Protecting train passengers in an emergency (49 C.F.R. part 239);
3. Co-worker deterrence of electronic device distraction and observing alcohol or drug impairment (49 C.F.R. §§ 219.405 and 219.407);

4. Radio communication procedures (49 C.F.R. § 220.61); and
5. Highway-rail grade crossing activation failures and protecting highway users from approaching trains (49 C.F.R. § 234.105).

The FRA points out these are only some of the examples of rules that cannot be complied with because they were designed for safe execution by at least two crewmembers. It is difficult for us to speculate how many more areas would be subject to complete overhaul to accommodate completely autonomous train operations. The Labor Organizations reserve the right to further respond to this question after having had reasonable time to review and consider comments submitted by and on behalf of railroad carriers.

23. *Are there current safety standards and/or regulations that impede the development and/or implementation of automated train systems or technologies in the railroad industry, including the development and/or implementation of autonomous rail vehicles? If so, what are they and how should they be addressed?*

The Labor Organizations reserve the right to respond to this question after having had reasonable time to review and consider comments submitted by and on behalf of railroad carriers.

Opportunities for Joint Government/ Industry Cooperation

24. *Are there current or anticipated railroad industry, private, international, or State or local government pilot projects or research initiatives involving automated train systems or technologies potentially in need of FRA support? If so, what are the needs (e.g., regulatory, technical)?*

25. *What data relevant to the development and integration of automated train systems and technologies currently exists that could be leveraged to address future government/industry research needs?*

The Labor Organizations would be remiss if we did not note that Positive Train Control (PTC) likely is the most comprehensive current technology and safety initiative in the industry today. As FRA well knows, design and implementation of PTC has been a long and difficult journey. Indeed, so many obstacles have been identified by railroads during the past decade, when the legislative mandate first was enacted, that we wonder what true insight can be offered into systems that are orders of magnitude more advanced than PTC. That being said, our experiences with PTC can identify both signposts and pitfalls for automation technology.

Even where new technology is regulated, railroads have demonstrated an inability to comply. The performance based Positive Train Control (PTC) rule is a good example of the significant shortcomings of the industry when it comes to the timely implementation of safety technology mandated by the FRA. PTC systems were mandated by Congress in 2008 to be fully implemented by December 31, 2015. When unable to implement the technology by said date, the railroads were granted an extension by Congress to 2018-2020. As of this time, less than ten of the 37 railroads required to install PTC have fully done so, with many lagging woefully behind on meeting the extended deadline.[28]

We restate our concern that human factors of train crews or other rail crafts could be traded for human factors of software engineers and consultants; swapping a known set of risks for an unknown set of risks. A question that comes to the forefront is how FRA will ensure the agency will have the staff with the expertise to understand whether or not a piece of software code is sufficient enough to be fail-safe. Moreover, FRA cannot and should not shoehorn the intended use of PTC as way to change the discussion to automation. The rail industry has been slow to adopt PTC since its first recommendation and it remains unclear how PTC will operate with other automation technologies being deployed by the railroads such as on board fuel savings software (e.g., Trip Optimizer, LEADER, etc.) and remote control operations in and around yards.

PTC will be a useful tool in preventing the worst types of accidents that result from incursions into unauthorized territory and beyond stop signals, and excessive speed. However, regarding design and data transfer, FRA has correctly warned that[29]

> Railroads and PTC system designers need to be made aware that measures can be taken in the design of PTC displays and in development of user training to improve train crew performance and reduce the potential for human error and made suggestions for ways to improve in-cab displays to reduce cognitive demands on train crews and facilitate train crew performance as well as suggestions for improved training.

The above data transfer systems could include non-visual, auditory, and tactile displays, as well as combinations thereof. The focus should be on minimizing technological intrusion into human decision and performance. Automation should serve the train crew, not the other way around. It needs to be the "team player" that Dekker discussed.

These human factor issues cannot be divorced from the realities of the introduction and implementation of autonomous systems and other systems like PTC into the cab of the locomotive. In an October 7, 2005 Memorandum to BNSF Railway from Jordan Multer, Victor Riley, Emilie Roth and John Wreathall, the group responded to a request from BNSF to perform a human factors analysis on the railroad's Electronic Train Management System or ("ETMS"). The group acknowledged the limitations of their work as a snapshot in time, but made several findings that are relevant and instructive then and today. Among these findings was the criticality of:

- How engineers handle ETMS trains vs. non-equipped trains;
- The impact of how easy or difficult it is to see the screens;

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[28] http://abcnews.go.com/Politics/railroads-meet-positive-train-control-deadlines-officials/story?id=53110861

[29] DOT, FRA, Technology Implications…, viii, 2009.

- the potential for distraction with the introduction of more screens to have to monitor while attempting to visually capture everything out the front window;
- the impact of workload and work mode transitions (Dekker also makes this point about mode changes);
- training;
- complacency;
- support for look-ahead;
- the impact on memory requirements of the engineer (information retained mentally vs. on paper vs. on screen;
- interaction with operating rules; and
- how ETMS may impact performance as it moves from a decision support aid to supervisory control (enforcement).

See Exhibit XXX.

PTC is not automation, but rather a communication system that informs a locomotive engineer when he or she may have to slow down or stop or perform a function with the train, and performs these tasks if the engineer fails to do so. It is a more airborne and processor-based way of communicating with trains rather than via hardwire, wayside signals and analog hardware system of communicating. Despite using newer forms of technology, PTC is accomplishing the same thing as the older, automatic train control (TC) signal system, but on a more sophisticated level.

The mere fact that a task is performed by one technology versus a different technology that happens to come later on the timeline of history, really does not merit a value judgment that newer necessarily equals superior. The Labor Organizations care most about a system that functions every time and is safe every time. PTC is a promising system that will save lives; train crews and the public will benefit from PTC with regard to the worst types of rail accidents it is designed to prevent. It is <u>not</u> a panacea for rail accidents and is <u>not</u> required to be installed on railroads that do not carry passengers or toxic inhalation or poisonous inhalation hazardous materials. It also does not perform or replace most of the cognitive functions performed by train crews and has not been mandated by law to do that. Thus, the challenges of dark territory operations will continue to face us on a significant portion of the Nation's rail network. The Labor Organizations reserve the right to further respond to these questions after having had reasonable time to review and consider comments submitted by and on behalf of railroad carriers.

<u>Conclusion</u>

Assumptions about automation should be treated with an abundance of caution. Because a certain automated part works on a car, does not mean it will work on a train. The Labor Organizations have a long history of co-existing with automated tools that date back to our founding well over a century ago. We plan on being at the forefront of new technology when it is integrated into our workplaces. And we have made an attempt to answer FRA's questions in a way that helps move the discussion forward, offering relevant expert information coming from human factors experts in transportation.

We rely on experts inside and outside of the rail industry who are credentialed in the areas of automation and human factors to help guide us in how we should proceed when automation is introduced. We have cited some of those experts in our comments to help inform ours and the public's understanding regarding automation and how it may best be implemented.

There can be a safe future working with automation rather than automation working without people. As in aviation/automation rail/automation should always include all crew members working to complement safety redundancy. Automation capabilities are changing and improving everyday. The tasks automation does today are not the same as in the past nor will be in the future. People also are not static in their capabilities or how they react to automation.

All industry stakeholders need to identify and understand the risks we are presented with as they are presented, and not merely make the blind-faith assumption that all technology is good in all circumstances.

Thank you for the opportunity to comment.

Respectfully submitted,

Dennis Pierce
National President, BLET/IBT

W. Dan Pickett
President, BRS

John Previsich
President, SMART-Transportation Division

Leo McCann
President, ATDA

Richard A. Johnson
General President, Carmen Division/TCU