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## **Free Speech vs. Regulation of Professional Engineers**

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Figure 1. Mats Järnlström, who wanted to express his ideas about traffic-signal timing

## 1. Introduction

In the United States, state licensing boards have the right to regulate the activities of persons engaged in the practice of engineering. Engineers in the United States also have a right—the right of free speech defined by the First Amendment to the Constitution. What happens when these two rights conflict? Precisely this question arose in the State of Oregon recently. What follows is the story of what happened when an overzealous licensing board tried to prevent a determined but unlicensed engineer from speaking publicly about an engineering issue related to public safety.

## 2. Powers of the Board

### 2.1 Oregon’s Licensing Statutes for Engineers

Perhaps the best place to start is to examine the rights of the Oregon State Board of Examiners for Engineering and Land Surveying and the rights guaranteed by the First Amendment. Among the Board’s powers are defining who can be called a “professional engineer”—the so-called “Title Laws.” The 2017 version of the Oregon Revised Statutes states that

“Engineer,” “professional engineer” or “registered professional engineer” means an individual who is registered in this state and holds a valid certificate to practice engineering in this state [1].

A takeaway from this wording is that “this definition treats the word ‘engineer’ as synonymous with ‘professional engineer’ and ‘registered professional engineer’ [2]. Anyone who describes himself as an “engineer” is *simultaneously claiming to be a “registered professional engineer.”*

Another of the Board’s powers is to decide who is engaged in “engineering practice”—the so-called “Practice Laws.” The relevant statute states that

(1) “Practice of engineering” or “practice of professional engineering” means doing any of the following:

(a) Performing any professional service or creative work requiring engineering education, training and experience.

(b) Applying special knowledge of the mathematical, physical and engineering sciences to such professional services or creative work as consultation, investigation, testimony, evaluation, planning, design and services during construction, manufacture or fabrication for the purpose of ensuring compliance with specifications and design, in connection with any public or private utilities, structures, buildings, machines, equipment, processes, works or projects [3].

This definition of “practice of engineering” is extended by another part of the statute [4]:

(1) A person is practicing or offering to practice engineering if the person:

(a) By verbal claim, sign, advertisement, letterhead, card or in any other way implies that the person is or purports to be a registered professional engineer;

(b) Through the use of some other title implies that the person is an engineer or a registered professional engineer; or

(c) Purports to be able to perform, or who does perform, any service or work that is defined by Or. Rev. Stat. § 672.005 as the practice of engineering.

Because, as has already been observed, an individual calling himself an “engineer” is simultaneously claiming to be a “registered professional engineer,” the portions of the statutes

just quoted imply *that the individual is necessarily practicing or offering to practice engineering*. Thus the individual calling himself an “engineer” and practicing engineering is violating not one but two statutes, if he is not registered.

## 2.2 How the Board Has Used its Power

The Board has used its powers aggressively, as is shown by some eyebrow-raising examples [5]:

- **The Board fines a retiree for complaining about his flooded basement.** A retiree wrote the Board a letter, complaining that city engineers in his home town had caused water damage to his home. The Board said they couldn’t do anything about the water damage. But they did fine the retiree for calling himself a “PE” (the abbreviation for a Professional Engineer) *in his letter*. [Emphasis added.] He had been a licensed professional engineer in Maryland for decades, but he wasn’t licensed in Oregon. As if the flooded basement weren’t enough, the Board fined him \$350 and subjected him to years of government enforcement.
- **The Board fines a different retiree for helping his daughter.** Another retiree testified on his daughter’s behalf in a property dispute, and a complaint was filed against him with the Board. The Board determined that the retiree had said “that he has been a mechanical engineer for over 40 years in court testimony, without stating that his registration was in retirement status . . . .” For that violation, the Board fined the retiree \$500.
- **The Board investigates a businesswoman based on a magazine article celebrating her achievements.** The “Oregon Woman 2015” edition of *Portland Monthly* included an article titled, “The incredible story of the engineer behind Portland’s newest bridge,” about a female immigrant and entrepreneur. Most readers probably found the article inspiring. The Board took a different view. It decided to open a law-enforcement case against the woman “because of the reference to [her] as an engineer in the on-line version of the story when in fact [she] is not a registered professional engineer.” Agency minutes suggest that a Board investigator even interrogated the journalist who wrote the article, before the Board finally dropped the case.
- **The Board investigates a local candidate for how he’s described in a voter guide.** In 2014, the Board received a complaint against a candidate for Portland City Commissioner. A voter pamphlet described the candidate’s occupational background as “environmental engineer.” The candidate [held] a B.S. in Environmental and Civil Engineering from Cornell, an M.S. from the MIT School of Civil Engineering, and membership in the American Society of Civil Engineers. He [was] not, however, an Oregon-licensed professional engineer, so the Board sprang into action. Nearly a year after receiving the complaint, the Board voted to warn the candidate against using the word “engineer” in “incorrect” ways.
- **The Board investigates a gubernatorial candidate for a political ad.** [In 2017], the Board voted to open an investigation into a candidate for the Republican gubernatorial

primary based on a complaint that he misused the word “engineer” in one of his political ads. In the ad, the candidate said: “I’ll take a different approach. I’m an engineer and a problem solver.” The candidate earned a B.S. in Mechanical Engineering from Purdue University, worked as an engineer at Ford and Boeing, and [earned] a string of engineering-related awards. Again, though, he [was] not an Oregon-registered professional engineer, so the Board launched a government investigation against him.

What is striking about these examples is that in every case no one was employed or under a contract to perform engineering work. All actions for which people were investigated by the board involved offering opinions for free or claiming to be an “engineer” in the common meaning—not the Board meaning—of the word. In other states, disciplining an engineer for performing paid engineering work without a PE license is common, but disciplining an engineer without a PE license for communications occurring outside the context of an employment or contractual relationship has occurred rarely if at all.

### **3. First Amendment Rights**

#### **3.1 Text of the Constitution**

The First Amendment to the U.S. Constitution states:

Congress shall make no law respecting an establishment of religion, or prohibiting the free exercise thereof; or abridging the freedom of speech, or of the press; or the right of the people peaceably to assemble, and to petition the Government for a redress of grievances.

Although the Amendment states that “Congress shall make no law, ... the Supreme Court has long interpreted the [Free Speech] Clause to protect against government regulation of certain core areas of ‘protected’ speech ... while giving the government greater leeway to regulate other types of speech, including a handful of limited categories that the Court has deemed largely *unprotected*. ... The Court generally identifies these categories as

- obscenity;
- defamation;
- fraud;
- incitement;
- fighting words;
- true threats;
- speech integral to criminal conduct; and
- child pornography” [6].

Some legal scholars may offer a slightly different list.

The Board has in effect claimed that an additional category of unprotected speech must be added to the list, namely, “describing oneself as an ‘engineer’ [2]” while not an Oregon registered professional engineer.

#### **4. The Mats Järnlström Case**



Figure 2. Intersection where Laurie Järnlström got a ticket

##### **4.1 Mats Järnlström’s Wife Receives a Red-Light Camera Citation.**

In May, 2013 Mats Järnlström’s wife, Laurie, drove her Volkswagen through the intersection of Allen Boulevard and Lombard Avenue in Beaverton, Oregon. A surveillance camera at the intersection detected that she had not entered the intersection when the traffic light turned from yellow to red, and she later received a notice in the mail stating that she was being fined \$260 [2, 7]. His interest piqued by his wife’s experience, Järnlström decided to study the engineering basis for traffic-signal timing. He “devoted approximately one-third of [his] time to the study and analysis of traffic light timing at intersections in the City of Beaverton” [8]. He concluded that the formula in current use did not take into account the additional time that would be needed were a driver to slow down and make a right turn at the intersection. His work, which included a

26-page paper [9] describing his ideas, generated interest among technically knowledgeable people. Little did he anticipate that speaking publically about traffic-signal timing would bring about a Federal court case pitting the right of free-speech guaranteed by the First Amendment against the right of the Board to regulate the engineering profession.

#### 4.2 Is Järnlström an Engineer?

In a declaration filed in support of a lawsuit [8], Järnlström described his background: “I was born, raised and educated in Sweden with an equivalent of an American degree of a Bachelors in Science in Electrical Engineering or higher, which has given me excellent mathematical and scientific skills. I did my military service in the Swedish Air Force as an airplane-camera mechanic. I also worked in Sweden as an audio engineer in the research and development department for Luxor Electronics, a subcontractor for both Volvo and SAAB. Additionally, I was an engineering consultant designing powered loudspeakers for Audio-Pro in Sweden before moving to the United States in 1992. Here in the United States I am a legal resident but *not a registered professional engineer [Emphasis added]*. However, my skills as an expert in motional feedback of powered loudspeakers, which includes the knowledge of motion of an object (distance, velocity and acceleration) such as a moving loudspeaker cone and the electro-mechanical-acoustical relationships in this type of a system, enabled me to work as an expert witness in the United States District Court in the Western District of Washington on behalf of Audio Products International (Robert Carver v. Audio Products International). Currently I am self-employed and conduct research and development with electronics and acoustics to develop new test and measurement methods. I also currently contract with the United States Navy to maintain, upgrade and calibrate digital storage oscilloscopes for the United States Naval Air Warfare Division that are used in the testing and evaluation of military ordinance.”



Figure 3. Mats Järnlström in his study

In the eyes of the Board, Järström was not an engineer.

### **4.3 Development of Formulas for Calculating the Yellow Change Interval**

Knowing a little history helps understand why Laurie Järström received her traffic citation and why Mats Järström became so eager to promote his theories. A paper entitled, “A History of the Yellow and All-Red Intervals for Traffic Signals,” was published in 2001, and the authors state that their review covers the “last 60 years” [10], so the problem of calculating the intervals has been around for a long time. An important development in that time span was the 1959 publication of the paper, “The Problem of the Amber Signal Light in Traffic Flow,” by Denos Gazis, Robert Herman, and Alexei Maradudin, in which the authors derived a formula that became the standard for interval calculations for many years [11].

In July, 2013, Maradudin, at that time Research Professor of Physics at the University of California at Irvine, and the last surviving author of the 1959 paper, sent a letter to the California Traffic Device Committee, pointing out limitations of his formulas in general and then giving a “partial list [10 items] of common situations where the formula does not provide a long enough minimum amber time” [12]. Turning movements were on the list.

Two years later, Maradudin wrote another letter, this time to the Institute of Transportation Engineers (ITE), stating that “it is gratifying that the work I and my fellow researchers, Denos Gazis and Robert Herman, did on this issue more than fifty years ago and which resulted in the equation that is now known as the Kinematic Formula, is still in use today. However, in reviewing [your proposed document], I am concerned that some of our work has been taken out of context, which will result in the Kinematic Formula being misapplied to situations where it cannot by its very nature, be applied” [13]. Maradudin then went on at length about the limitations of his work, including a clear statement that it does not apply to turning movements.

The relevance of these comments by Maradudin is that “For more than a decade, critics have charged that ITE has tinkered with the signal timing formula in ways meant to facilitate the adoption of red light camera enforcement. In 2001, the majority leader of the U.S. House of Representatives issued a report blaming the ITE formula for creating a ‘red light running crisis’ with inadequate yellow warning times” [14]. If turning drivers are not given an adequate yellow interval to slow down and make their turn, then red-light cameras will unfairly report these drivers as violators. Beaverton’s red-light camera system seemed particularly biased against turning drivers:

“According to an investigation by local TV station KOIN 6, Beaverton issues up to six times as many traffic tickets as similar-sized cities.

Until 2010, the city only issued tickets to drivers who ran red lights going straight. That year 1,759 tickets were written. But in 2011, when Beaverton began handing out tickets



for right hand turns, that number skyrocketed to 5,653 and then 7,955 in 2012. In 2015 the ratio was still lopsided: 2,062 tickets for drivers going straight and 5,538 for those turning on red.” [15, 16]

How can this be explained? Are turning drivers less law-abiding than drivers who go straight? Or, more likely, was Järllström correct that formulas currently in use for calculating the yellow change interval did not account adequately for vehicles making a turn at an intersection.

## 5. Timeline of Järllström’s Activities

**Järllström’s story has four main threads:**

- 1) He sues Beaverton and loses.
- 2) He publicizes his theories to gain recognition so that they will be implemented.
- 3) The Board investigates and fines him.
- 4) He sues the Board and wins on almost all of his complaints.

### **2014 May 13. Järllström Files Civil-Rights Lawsuit Against Beaverton.**

Järllström had presented his work to the Beaverton City Council but “They literally laughed at me at City Hall,” Mr. Järllström recalled later [17]. As a result of the rebuff, on May 13, 2014 Järllström filed a civil rights case, challenging “the legality of the City of Beaverton’s yellow light intervals at signalized intersections, which are too short to comply with the Oregon Vehicle Code governing traffic control devices and expose plaintiff, other residents of the City of Beaverton and visitors to the City to serious risk of injury or death when attempting to cross these intersections as pedestrians or in a vehicle” [18].

### **2014 September 3. Järllström Emails Board Asking for Help and Support.**

To whom it may concern,

I would like to have your support and help to investigate and present the laws of physics related to transportation engineering in the State of Oregon. I am already working to “*protect the health, safety, and welfare of the general public*” especially in the City of Beaverton where the two transportation engineers are misreading Oregon Vehicle code, how the law applies to the laws of physics for a vehicle in motion traveling through an intersection and the well-known engineering practices. By misapplying engineering practices and Oregon law they are putting the public at risk.

I have spent a year investigating and I have a clear understanding how the law should be applied and why it is written the way it is. I have source documents for the wording of ORS811.260(4) which is the main misunderstanding by the City of Beaverton but also by the Oregon Department of Transportation. I would like to present these facts for your

review and comments.

If you are looking for a Board member I might be interested since I'm already doing this kind of work and it would be nice to get paid. My Swedish engineering degree is in electronics and I'm an expert in motional feedback (displacement, velocity and acceleration feedback) of powered speakers which includes the full understanding of motion of an object such as a loudspeaker cone (or a vehicle stopping or traveling through an intersection as in ORS811.260(4)).

Thank you.

Best regards,  
Mats Järnlström [19]

#### **2014 September 5. Board Responds to Järnlström.**

Mr. Järnlström:

The Oregon State Board of Examiners for Engineering and Land Surveying (BOARD) received your concerns. I reviewed background information regarding the specifics of your lawsuit (<http://www.jarlstrom.com/redflex/>). Please be aware that the Board has the authority to investigate allegations of violations of Oregon Revised Statutes (ORS) 672.002 to ORS 672.325 (see ORS 672.300). Therefore, allegations regarding violations of ORS 811, for example, fall outside the Board's authority. Before determining next steps, I would like to get additional information from you.

Specifically, you wrote that "two transportation engineers are misreading Oregon Vehicle Code." What are their names and contact information? Do you have any documentation showing they are/were in responsible charge of setting light timing? Has the City of Beaverton taken any action regarding your concerns? In order for the Board to open a complaint, we need to receive a written complaint along with evidence of violations within the Board's authority. For convenience, we have a complaint form you can complete and submit.

Furthermore, you wrote that you are "already doing this kind of work." It is not clear what type of work you are doing because it appears from your Web site that your specialty is acoustical services. Please describe what work you are doing and for whom.

Last, ORS 672.005(1) defines the practice of engineering. A separate definition of engineering is also provided in ORS 672.007(1). It is reprinted below for your convenience. [Omitted for brevity. Given in the beginning of this paper.]

ORS 672.020(1) prohibits the practice of engineering in Oregon without registration. At a minimum, your use of the title “electronics engineer” and the statement “I’m an engineer” are examples where the definitions of engineering under ORS 672.007(1)(a) create violations under ORS 672.020(1) and ORS 672.045(2). You should stop any further references until you become registered with the Board. Here is a link to the [Board's Examination Information and Applications](#) Web page.

In the meantime, please provide the requested information so we can determine next steps.

jrw

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**James R. (JR) Wilkinson**, Investigator, Oregon State Board of Examiners for Engineering and Land Surveying [19]

Thus Järllström’s email asking for support and help is answered with an accusation of violating the law by calling himself an “engineer” without being registered.

#### **2014 October 14. Judge Dismisses Suit Against Beaverton.**

The court dismissed the suit for lack of standing, claiming that the chance of injury to Järllström from the short yellow light intervals was too small for Järllström to have standing to pursue his claims as a civil rights case under federal law. But as Järllström’s attorney put it, “the decision in no way upholds the City of Beaverton's yellow light timing system, but dismisses the case purely on a procedural technicality”. Järllström expressed his opinion of the legal proceedings by starting a webpage in which he stated that the two judges involved “did not understand” the complaint, the wording of the Oregon Vehicle Code, or the evidence presented. [H]is conclusion: “The Judge’s actions show that a Courtroom is not the place to discuss mathematics and the laws of physics” [20].

#### **2015 January 13. Järllström Emails NCEES, Maradudin, 60 Minutes, and the Board.**

In a further effort to gain acceptance for his work, Järllström “sent an email to Lehmon Dekle with the National Council of Examiners for Engineering and Surveying, Dr. Alexi Maradudin ..., *60 Minutes*, and the Board, explaining how he had, ‘solved the slowing down *within critical stopping distance* dilemma’ of the yellow change interval timing formula and attached a document with his calculations and a traffic change interval timing formula including algorithms he created, and which he promoted as a replacement for the traffic change formula commonly used. He asserted that his new formula ‘will have worldwide impact’ and resolve the current misapplication of the original change interval timing formula.” [21]

After Järström had an opportunity to speak with Maradudin, Järström exulted, "He wants me to continue with this, it's amazing that I have his support." [22] Maradudin later told an interviewer about Järström, "I'm pretty well convinced he's right". [23]

**2015 January 15. Järström Emails the Board Stating, "[Y]es, I'm an excellent engineer."**

He included an email he had written to Portland television station KOIN 6 in which he introduced himself as a Swedish engineer, and presented his findings on traffic-signal timing [22].

**2015 February 12. Board Opens Investigation.**

Apparently the Board had had enough of Järström's flaunting of the Board's rules prohibiting non-PEs from speaking publicly about technical issues and prohibiting non-PEs referring to themselves as "engineers." They sent Järström the following letter [24]:

Dear MATS JARLSTROM:

The Oregon State Board of Examiners for Engineering and Land Surveying (BOARD) has opened an investigation regarding whether you engaged in the unlicensed practice of engineering per Oregon Revised Statutes (ORS) 672.007(1).

You may recall that on September 3, 2014, you contacted BOARD to solicit support and an investigation into "two transportation engineers [who] are misreading Oregon Vehicle code." The allegations were related to ORS 811.260(4) and you wanted to present facts for the Board's review and comment. When I replied on September 5, 2014, I noted that the Board does not have authority over ORS 811, requested that you complete a complaint form and submit evidence to initiate the complaint process, and provided a reprint of ORS 672.007(1). I informed you at the time that use of the title "engineer" without registration is prohibited in Oregon. I asked you to stop any further use of the title until you became registered. You agreed.

However, the allegations are that you then continued to use the title "engineer" in your communications with Board staff and, of more concern, are the documents you provided that indicate you may have engaged in unlicensed engineering work in Oregon. As a result of your emails, the Board's Law Enforcement Committee directed on February 12, 2015, that an investigation be opened against you, separate and distinct from any investigation or potential enforcement action that may be taken against the transportation engineers who were the subjects of your initial inquiry.

Please note that the Board reviews all allegations to determine whether grounds exist to warrant action. Your written response to the allegation is important: it allows you an

early opportunity to provide the Board with information from your perspective and it assists the Board in making a decision about whether to pursue an enforcement action. Copies of the most relevant documents are enclosed for your review ...

Sincerely,

James R (JR) Wilkinson, Investigator

**2015 March 6. Järlström Emails Washington County Sheriff, Patrick Garrett.**

Järlström states, "I have actually invented and publicly released a new extended solution to the original problem with the amber signal light in traffic flow" [21].

**2016 August 14-17. Järlström Presents a Paper at a Technical Conference.**

The paper was titled, "An Extended Solution to the Yellow Change Interval Duration" [25].

**2016 November 1. Board Issues Notice of Intent to Impose a Civil Penalty.**

"Järlström had written about his work to his local sheriff, to Dr. Maradudin, and to 60 Minutes about his calculations. The board considered each of these a violation" [23]. "All told, the Board listed nine separate violations and fined Mats \$500" [5]. On advice of his attorney, Järlström paid the fine because the Board could conceivably increase the fine to \$1,000 for each of the nine violations.

**2017 January 12. Board Acknowledges Receipt of Järlström's \$500 Payment and Issues Final Order.**

The Final Order confirmed the alleged violations given in the Notice of Intent. [21]

**2017 April 25. Järlström Files Civil-Rights Lawsuit.**

With the assistance of the Institute for Justice, a non-profit group that supports First Amendment rights—especially as those rights are related to employment opportunities, Järlström filed suit, arguing that "no matter how technical the topic, the government cannot give state-licensed experts a monopoly on exchanging ideas. He also challenged Oregon's ban on people truthfully calling themselves 'engineers'" [5].

Institute attorney Sam Gedge said that in Järlström's case,

Oregon's engineering board is an extreme example of a state agency targeting speech. But it's hardly unique. Kentucky's psychology-licensing board took aim at a nationally syndicated advice columnist for writing about behavioral issues without a Kentucky license. North Carolina's dietetics board took a red pen to a citizen's diet blog. And

Texas's psychologist-licensing board threatened to punish a political candidate who referred to herself—truthfully—as a "psychologist" in her campaign materials [23].

A New York Times writer pointed out a special feature of the Institute's intervention in Järlström's case:

What is unusual about Mr. Järlström's case is that it does not involve any commercial pursuits, advertising or other moneymaking efforts. Instead, he accuses the board members in his suit of interfering with free speech [17].

**2017 May 30. Preliminary Injunction Issued.**

The injunction allowed Järlström to describe himself as an "engineer," and to speak publicly about his theories during the time before final disposition of the lawsuit. The injunction, with slight changes, was made permanent in the Final Order [26]

**2017 August 18. Board Refunds \$500 Fine to Järlström.**

In her Opinion and Order, the judge mentioned that the Board refunded the \$500 fine to Järlström [2].

**2018 December 28. Judge Issues Final Order.**

Conclusion [2]:

1. Plaintiff Järlström may study, communicate publicly about, and communicate privately about, his theories relating to traffic lights as long as Plaintiff Järlström's communications occur outside the context of an employment or contractual relationship relating to the timing of traffic lights with a governmental or other entity that changes or implements or has final approval to change or implement traffic-light timing without the review and acceptance of responsibility by an Oregon-licensed professional engineer.
2. Plaintiff Järlström may describe himself publicly and privately using the word "engineer."



Figure 4. Mats Järnlström won his lawsuit.

Thus the judge ruled that Järnlström may voice an opinion publicly about traffic-light timing and may call himself an engineer, even though he is unlicensed. The assistance of the Institute for Justice was vital in obtaining this ruling, but equally important was the dogged determination displayed by Järnlström in fighting for his right to speak about a technical matter related to public safety.

In footnote 3, the judge remarks that the Board has revised its regulations:

The Court notes that the Board has promulgated new regulations that will prevent the Board from applying the Practice laws to Plaintiff’s proposed future activities, as well as to those of any similarly-situated individuals engaged in engineering outside of a commercial or professional context. (“[P]rofessional service” and “creative work” apply only to labor “provided in a commercial or professional context”).

## 6. Epilogue

### 6.1 ITE Recognizes Järnlström’s Work

In a March 2, 2020, press release, the Institute of Transportation Engineers announced that it “has issued guidance on yellow change and red clearance intervals for signalized intersections.

The recommended practice—*Guidelines for Determining Traffic Signal Change Clearance Intervals*—was developed by a committee of subject matter experts (SMEs) and a separate SME review panel and ITE staff.” A “major change to recommended practice was use of the extended kinematic equation [Järlström’s equation] rather than the traditional kinematic equation for calculating yellow change intervals [27, 28, 29].” Järlström’s publication on the extended kinematic equation was explicitly cited in the Guidelines—a clear sign that the validity of his work has been recognized by the experts in the field.

## 6.2 Relation to the Classic Argument for Free Speech

The purpose of a board for regulation of engineers is to protect the public. Thus it is ironic that when Mats Järlström attempted to protect the public from the dangers of improperly timed traffic signals, the Board tried to silence him. The Board saw its duty to be that of limiting technical discussion to those persons who had proper credentials, even though people without credentials might have contributed significant information to the discussion and hence to the protection of the public. One of the traditional arguments for free speech is that the wider the range of opinion that is heard, the more likely the truth of a situation will be discovered. The nineteenth-century English philosopher, John Stuart Mill, wrote in his famous essay, *On Liberty*, [30]

The peculiar evil of silencing the expression of an opinion is, that it is robbing the human race; posterity as well as the existing generation; those who dissent from the opinion, still more than those who hold it. If the opinion is right, they are deprived of the opportunity of exchanging error for truth: if wrong, they lose, what is almost as great a benefit, the clearer perception and livelier impression of truth, produced by its collision with error.

Mill’s analysis applies to the present situation. The *peculiar evil* of silencing Järlström’s opinion is that it robbed traffic engineers of the opportunity of exchanging error (the previously existing equation) for truth (the equation reflecting Järlström’s work). When the engineers learned of Järlström’s opinion, they were able to exchange error for truth and modify the procedure for timing signals. The result of widening “the range of opinion that is heard” is expected to be a decrease in unfair traffic citations and in accidents causing injury or death.

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