

Operational Risk and Real-Time Electronic Trading  
ISI Technical Note  
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One of the first assessments of the operational risk inherent in a financial information system occurred over 130 years ago. The electronic information processing technology was based on telegraphs powered by electricity (supplied by chemical batteries). The infrastructure was connected by wires — but to save money the wires were often not insulated. The batteries would sometimes explode. A vivid description of a breakdown is described by a new Wall Street hire:

On the third day of my arrival [on Wall Street]... the complicated general instrument for sending on all the lines, and which made a very great noise, suddenly came to a stop with a crash. Within two minutes over three hundred boys – a boy from every broker in the street – rushed upstairs and crowded the long aisle and office, that hardly had room for one hundred, all yelling that such and such a broker’s wire was out of order and to fix it at once. It was pandemonium, and the man in charge became so excited that he lost control over all the knowledge he ever had. I went to the indicator, and, having studied it, thoroughly knew where the trouble ought to be, and found it... Doctor Laws appeared on the scene, the most excited person I had seen. He demanded of the man the cause of the trouble, but the man was speechless. I ventured to say what I knew what the trouble was, and he said “Fix it! Fix it! Be quick!”... In about two hours, things were working again...

Thomas A. Edison, describing his first job on Wall Street in 1868.  
Reported in *Edison, His Life and Inventions*, by F.L. Dyer and T. C. Martin, Harper & Brothers: New York 1910.

After this event, Edison was hired by Dr. Laws (Vice President and "chief information officer" of the Gold Exchange) for the then princely sum of \$300 per month (a reasonable insurance policy). The cost of the two-hour breakdown was not given.

Dr. S. Laws created the first real electronic operational infrastructure on Wall Street in 1866. Laws set up an information service where gold quotes were telegraphed from the New York Gold Exchange (then located around the corner from the New York Stock Exchange on New Street) to a “central.” There, the quotes were distributed to any subscriber electronically connected to an “indicator.”

Indicators displayed quotes on a moving dial marked in eighths; four electronic pulses from the central were required to move the dial between the fractions. The significant innovation (based on two circuit closing keys which Laws patented) was that subscribers were not required to know Morse code to use the system! Within a year, Laws’ Gold Reporting Telegraph had fifty subscribers. The Gold Indicator Company also hired a 21-year old telegraph operator named Thomas Edison to keep the central system from crashing.

Laws also installed long lines of "speaking tubes" because of his "distrust" of the telegraph system of electric wires: probably the first application of fault tolerance in an assessment of operational risk.

In 1867, a competing system was developed by D. Callahan at the New York Stock Exchange, where a printing wheel was substituted for a display wheel. Callahan's innovation was a kind of printing telegraph (called a *ticker* because of the sound of the impact printing). His Gold & Stock Telegraph Company at 18 New Street was so well capitalized that they started using insulated wires (costing 40 times as much as bare wires), to prevent the short-circuits caused by mice and insects and bugs.

Both systems relied on the telegraph and telegraph operators. In some ways, the telegraph operator was similar to today's software engineer. The telegraph operator was a highly paid technologist whose primary task was to write and read Morse code, the standard language of the day. Reconstructing transmitted code was difficult: because of the "noisy domain" (misspellings, missing words, missing sentences, poor insulation, crashes), translation was based on the context and semantics of the material. Edison said that receiving operators often had to make up 20% of the text. Good operators had to be constantly aware of current news events and price movements in the primary markets.

The competition between tickers and indicators ended with a merger. In 1869 the new Gold & Stock Telegraph Company then hired Edison and Franklin Pope, a fellow telegraph operator (they founded Pope, Edison & Co., with offices at 78 Broadway), as consultants. Edison developed a "universal ticker" to be used on an international scale. His user interface design was that the new system should be simple to operate, because "they did not have the experts we had in New York to handle anything complicated." Today, his design ideas would be called "object oriented."

The parts were standard and interchangeable. Edison said there are three types of interchangeability: first, the parts fit; second, they will "almost" fit; third, they do not fit, and can't be made to fit. These observations are still true today.

Approximately 1200 universal tickers were installed. Subscribers paid \$100 per machine and \$25 per week for the service.

The development of technology coincided with an active speculation in gold (maybe one fueled the other). In those post-Civil War days, "the fluctuations in the price of gold at every instant meant fortune or ruin to thousands." This actually happened on Black Friday, September 24, 1869, when Jay Gould tried to corner the gold market.

On Black Friday we had a very exciting time with the indicators...On the morning...the indicator was quoting 150 premium whereas the bids by Gould's agents in the Gold room were 165 for five millions or any part. We had a paper-weight at the transmitter and by one o'clock reached the right quotation...New Street as well as Broad Street was jammed with excited people...I sat on top of the Western Union telegraph booth to watch the surging crazy crowd....When James Brown, of Brown Brothers & Company broke the corner by selling five million gold, all payments were repudiated by Smith, Gould & Martin ...but they continued to receive checks ...until the Street got wind of the game.

There was some kind of conspiracy with the Government people which I could not make out, but I heard messages that opened my eyes as to the ramifications of Wall Street. Gold fell to 132, and it took us all night to get the indicator back to that quotation. All night long the streets were full of people. Every broker's office was brilliantly lighted all night, and all hands were at work. The clearing-house for gold had been swamped, and all was mixed up. No one knew if he was bankrupt or not.

Edison later sold his rights to the ticker for \$40,000. Franklin Pope, Edison's partner, later became president of the American Institute of Electrical Engineers — the forerunner of the Institute for Electrical and Electronic Engineers (IEEE). After leaving Wall Street, Dr. Laws became president of the State University of Missouri.