



26 May 2023

## Social network mapping and return on human investment: New continuous quality improvement tools.

### Aim of blog

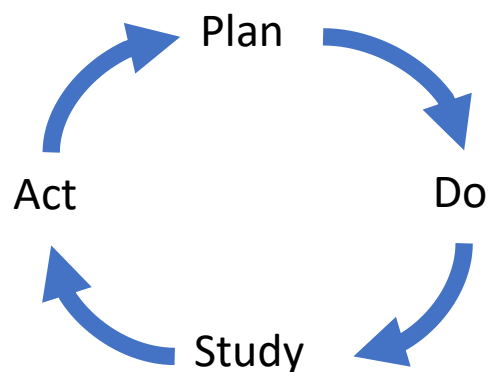
The purpose of this blog is to present a set of new continuous quality improvement measures through a case study.

### Case study

During a tour of the Spectra Physics Scanning handheld scanner assembly line in 1994, manufacturing associates told me that they were working overtime and on weekends to replace scanners that failed final inspection. Once a laser motor was glued to a laser motor shaft, the motor was turned on and the laser light beam *wobbled* when pointed at a measurement grid. Laser motor wobble resulted in scrapping nearly complete scanners that needed to be replaced.

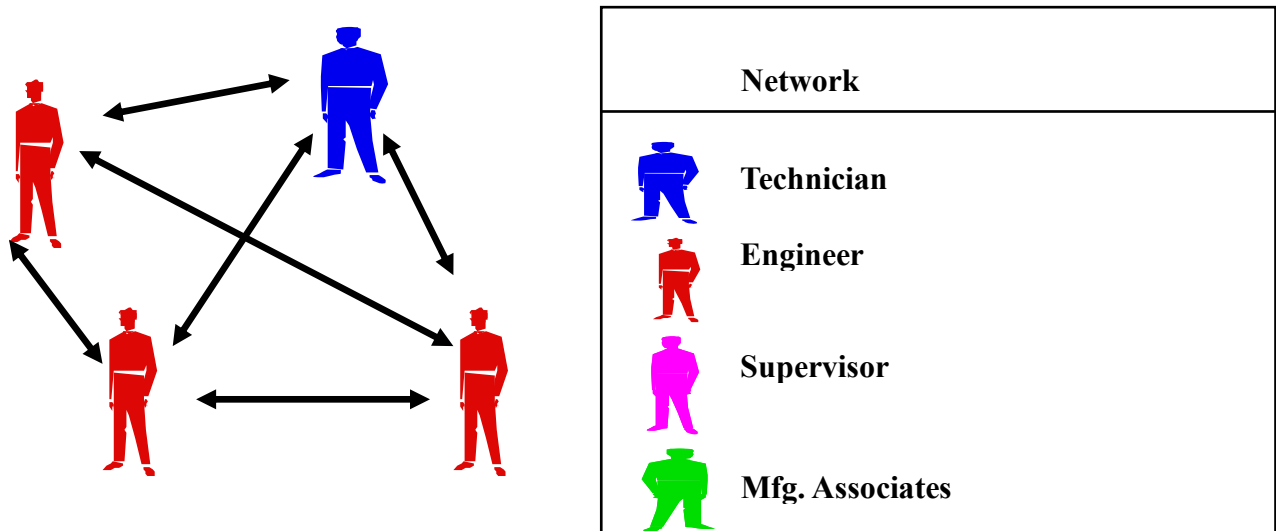
### Continuous quality improvement cycles

Dr Deming described continuous quality improvement as a cycle of plan-> do -> check ->act, later replacing *check* with *study* [1-3].



## Continuous quality improvement social network (baseline)

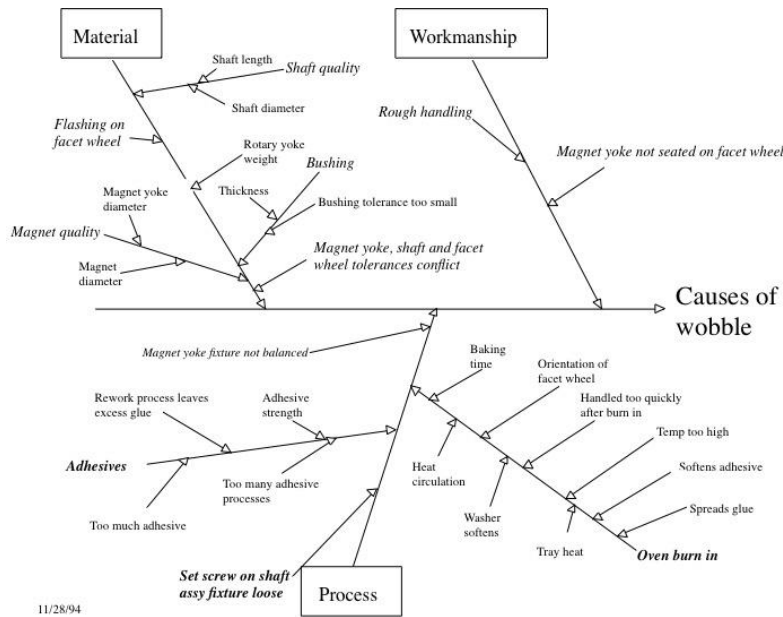
Managing research at the University of Oregon I had begun using social network analysis to understand social support networks for new employees with developmental disabilities [4, 5]. I sent out a survey asking the manufacturing associates, product engineers, technicians and supervisors who were building the handheld scanner, *With whom do you study laser motor wobble?* This showed me the social network structure of the study phase of Demings quality improvement cycle. Each employee completed the survey listing those they studied laser motor wobble with. The results showed a small social system, a network where everyone in the network sees everyone else in the network as a collaborator studying laser motor wobble and that manufacturing associates were not involved in the continuous quality improvement cycle.



## Using quality improvement tools to empower manufacturing associates to solve laser motor wobble

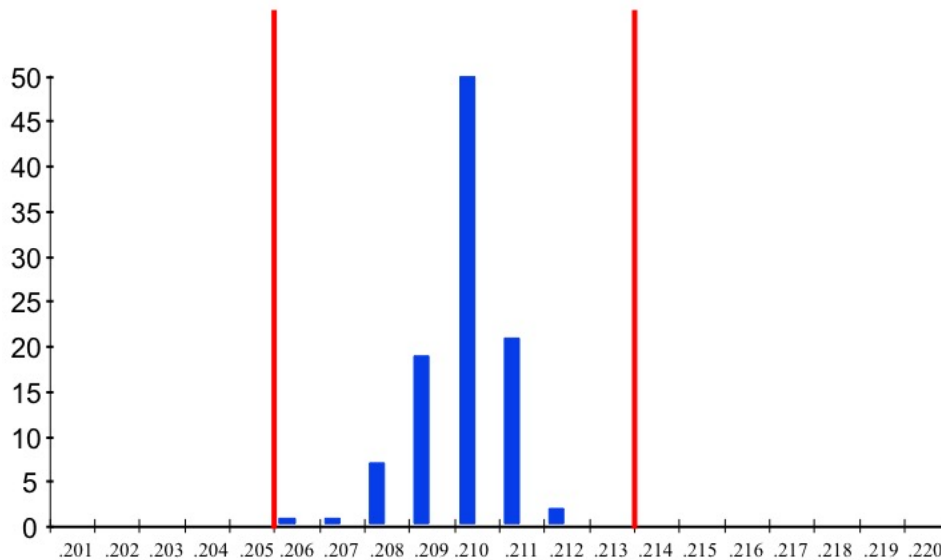
I proposed teaching quality improvement tools to the manufacturing associates so they could study laser motor wobble. Company managers were concerned about the time it would take away from manufacturing associates' assembly of scanners so we agreed that I would do the teaching during breaks and account for the labor costs of studying laser motor wobble.

We began with a fishbone diagram showing all the factors relating to laser motor wobble.



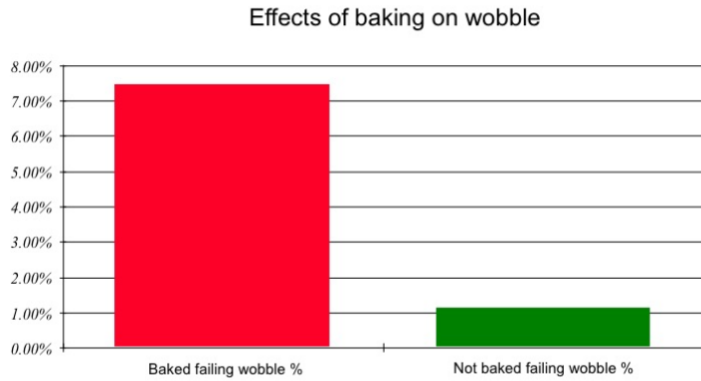
Meeting to discuss potential factors contributing to laser motor wobble the manufacturing associates chose to focus on *bushing length* and used a histogram to study the quality of the bushing length. The red lines show the quality tolerances. Data falling between the red lines met the quality criteria.

Bushing Length .210 +/- .004



Discussing this data during a work break, a shy assembler spoke up. He thought that the oven being used to accelerate the drying of the adhesive used to glue the laser motor to the laser motor shaft was the source of the quality failures. Together we set up an experiment. Some

laser motor assemblies continued to go through the oven, while we let other laser motor assemblies to dry without the oven.

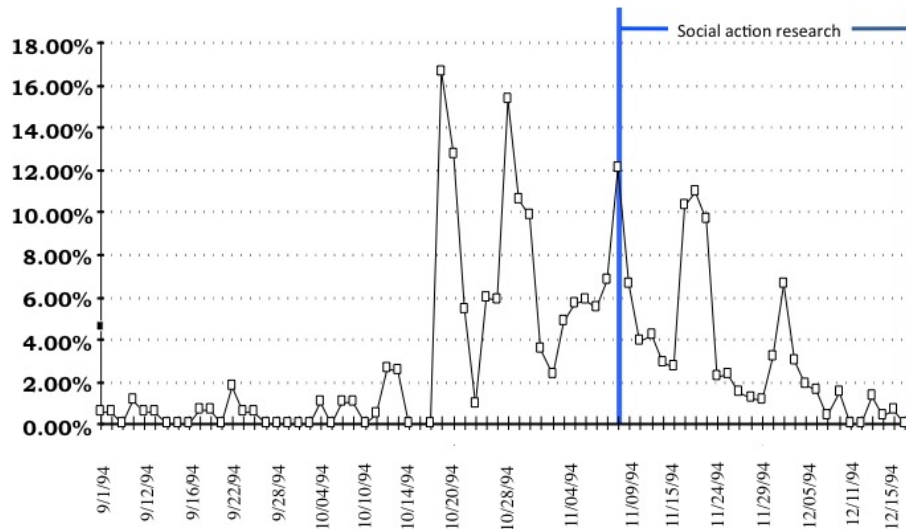


This data was used to propose to management that the step using the oven to “bake” the laser motor assemblies be discontinued. Management accepted our proposal. The manufacturing associates solved the laser motor wobble problem. Using statistical process control charts, we isolated three phases. The first phase was our baseline, before the manufacturing associates began studying wobble. The second, shows the impact of the manufacturing associates’ solution and the third phase shows the process out of statistical quality control when an engineering manager reinstated the oven to bake the assemblies.



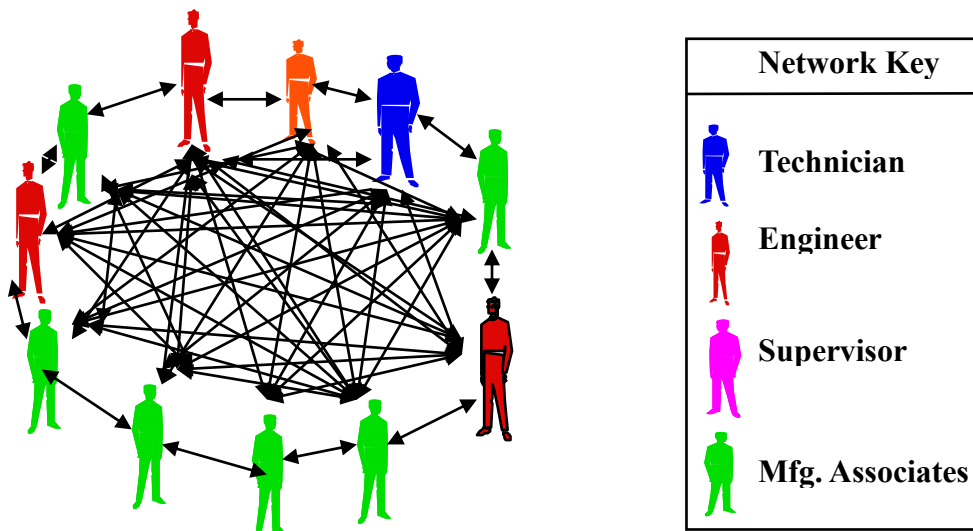
Finally, we used a simple line graph to show the history of laser motor wobble and the impact manufacturing associates made during the social action research.

### Percent reject due to wobble



### Continuous quality improvement social network update

Now that we had evidence of the impact the manufacturing associates had on solving laser motor wobble, I once again asked manufacturing associates with whom they study laser motor wobble. The network once again showed everyone in the network connected to everyone else in the network, or a social system, that now included manufacturing associates and me shown as the orange figure.



## Return on human investment

Spectra Physics management had asked me to keep track of the labor cost related to the manufacturing associates studying laser motor wobble. I broke the costs down to training costs, team meeting costs and data collection costs.

### Cost of studying wobble

Training costs.....	\$84.50
Team meetings costs.....	\$147.88
Data collection costs.....	\$ 29.58
Total cost of studying .....	\$262.00

### Changes in the cost of rejection due to wobble

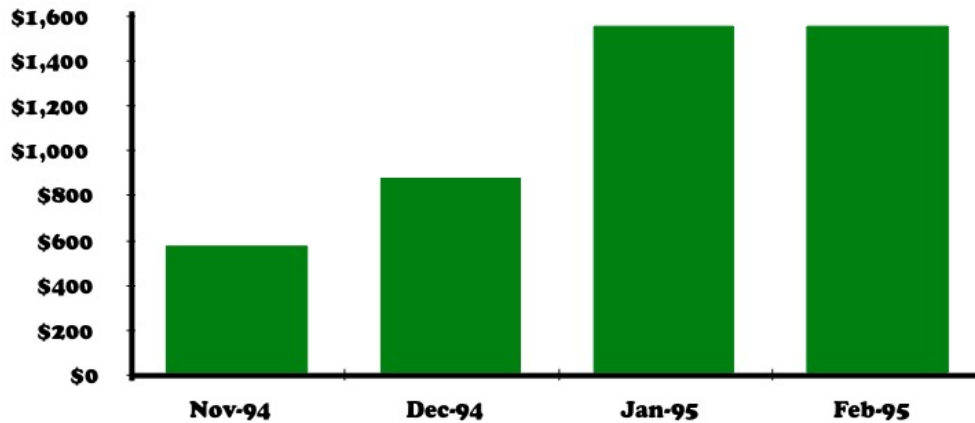
November cost saving.....	\$ 577.00
December cost savings.....	\$ 874.00
January cost savings.....	\$1,556.00
February cost savings.....	\$1,556.00
Change in cost due to wobble rejection.....	(\$4,563.00)

Return on human investment..... 17.42:1

The cost of manufacturing associates studying laser motor wobble was \$262.00 and the cost savings was \$4,563.00. The return on human investment is a ratio of the cost of human investment (training, team meetings, data collection) divided by the cost savings. In this case study the return on including manufacturing associates' study of laser motor wobble was 17.42. For every dollar Spectra Physics spent on manufacturing associates studying laser motor wobble, the company received a \$17.42 return.

Because the manufacturing associates brought the laser motor assembly under statistical process control their cost savings accrued on a monthly basis.

## Monthly cost savings



### Team performance is determined by the social network structure

While I was a vendor of Hewlett Packard, HP engineers invited me to a continuous quality workshop featuring Ishikawa's quality improvement tools including histograms, pareto analysis, fishbone diagrams, check sheets, run charts and statistical process control charts [6]. I believe social network mapping belongs right beside the Ishikawa tools.

In this case study, the social network structure changed. It expanded to include manufacturing associates. And by studying the costs and benefits of this structural change in the social network we discovered a positive financial impact. So, we can see that the performance in social networks is determined by its structure.

Participation in the social action research was not required. While management approved of it, they did not encourage participation. While I was a data collector for the manufacturing associates, I did not guide their decision making process. I offered training on the Ishikawa continuous improvement tools, and they used them beautifully. This tells me that the manufacturing associates participated because they wanted to. They preferred to participate in problem solving, improving productivity, and minimizing waste. So they did.

## An action research study of social action research

An MBA student at the University of Oregon was the CFO of Spectra Physics Scanners. He found me in the production area one day and asked if he could conduct a action research study of my social action research which was in process at the time.

The action research was operating on two levels the first being conducting an action research project 'in action' and the second being an analysis of human investment and return on human investment.

This was a very high quality action research project. The steps they followed are aligned sequentially with the text book approach. More important is the method in which (Dennis) involved the work group in every phase of the research teaching qualitative and quantitative skills to the motor team that enabled them to conduct the research. The anticipated result is a strong reinforcement and empowerment of the resultant recursive effect.

The fact that he included a monetary analysis of return on investment is to be applauded. This type of payback analysis is rare in research and yet is usually the most important factor when determining the effectiveness of continuous improvement.

The actual savings seem to be substantially understated and therefore the monetary impact of the project understated.

The process employed makes use of the critical principle of collaboration, incorporation of local knowledge and eclecticism and diversity that enables action research to be truly successful. Their work seems to epitomize Kurt Lewin's view of 'There is no action without research and no research without action.'

Manufacturing Associates comments

What did you like the best? 'It enabled members of the motor team to interact and actually work as a team to solve a problem.'

What did you like the least? 'The lack of time to do justice to the new techniques.'

The team saw this as a positive experience and were acting in good faith to improve their area, not to satisfy the needs of the researcher. [7]



## Improving quality improvement

Waste of materials, waste of human effort, and waste of machine-time have been deplored in earlier chapters. Waste of knowledge, in the sense of failure of a company to use knowledge that is there and available for development is even more deplorable, more devastating. No company can afford to waste knowledge. Failure of management to break down barriers between activities (production, design, purchase)... is one way to waste knowledge. People that are not working together are not contributing their best to the company. People as they work together, feeling secure in the job reinforce their knowledge and efforts. Their combined output, when they work together, is more than the sum of their separate abilities. [2]

In this social action research case study, I used social network mapping and return on investment to demonstrate to Spectra Physics management that when manufacturing associates were empowered to study the quality of their work, the company received a positive financial return.

While accomplishing this, I see more opportunities for improving quality improvement. First of all, the CFO of Spectra Physics could have been invited to join in the study and solution of laser motor wobble. This would have led to a more accurate analysis of the financial impact the manufacturing associates had. Second, when we study and eliminate waste in manufacturing, we improve the sustainability of the organization. This second opportunity of documenting changes in the manufacturing waste stream should guided sustainability efforts and organizational learning.

Finally, in a 2014 Society for Organizational Learning meeting in Paris, Arie de Gues offered this call to action.

I think what is needed, what is waiting for you, the next generation, is to find ways to change the internal structures of business and governmental institutions to become much more in harmony with the value systems that have developed since the second world war. That's your job. That's waiting for you and that's a very difficult problem. That's really organizational learning by accommodation. Re-read Piaget. Then you know what you've got to do. [8]

The social action research case study shows us how changing the internal structure of Spectra Physics continuous quality improvement processes from hierarchical divisions of labor to collaborative social systems had a positive social impact (the manufacturing associates felt empowered to solve problems), a positive financial impact (the benefits to Spectra Physics were much greater than the costs) and a positive environmental impact (fewer laser motor assemblies entered the waste stream).

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