The following pages provide and outline and summary of FreePoint's recent research project, in collaboration with Fanshawe College and funding assistance from OCE and NSERC.

Ontario Centres of Excellence
Where Next Happens

Natural Sciences and Engineering Research Council of Canada

FANSHAWE

Project #: 22501 "*Deploying real-time data collection for measuring overall equipment efficiency (OEE) as a productivity tool in manufacturing*"

Project Purpose:

To establish that measuring value adding activities empirically, establishing key performance indicators (KPIs) that are meaningful and relevant to assemblers and operators, and sharing those KPIs with the assemblers and operators in real-time will have a significant and positive effect on productivity.

Background:

FreePoint Technologies was founded in 2013 by Randy Hess and Paul Hogendoorn - two seasoned entrepreneurs familiar with the needs and challenges facing manufacturing, and equally familiar with information technology available today.

In 2013, FreePoint acquired a root technology from St. Clair Technologies, a company that Randy co-owns and is a director of, and then further developed that technology into a product that had broad industry application. A provisional patent was applied for in 2013 and is currently pending.

In 2013 and 2014, FreePoint deployed the resultant technology in several "early adopting" customers in order to prove out the basic value proposition – that an engaged workforce could be a more productive and happier work force.

Having established "anecdotal proof" with a small user group, FreePoint developed a cloud based SaaS offering, filed a second patent application, and concluded that an empirical study was needed to help the market accept FreePoint's paradigm challenging value proposition.

Test Site Selection:

FreePoint looked at a wide number of local manufacturers that had an interest in the type of project that we were proposing. We concluded that we needed 2 different types of manufacturing companies involved: a steady state manufacturing operation, and a job shop manufacturing operation.

Job Shop Manufacturer: '***Company A***' is a 40 year old London area company that employs 120 people. They are primarily a tool and die and solutions manufacturer for automotive customers. They have 20 machines that are critical to their manufacturing processes. Their business order book was consistently full so any productivity gains would result in direct bottom line gains. We selected 6 machines that represented a good mix of regularly operated machines for the test.

Steady State Manufacturer: '***Company B***' is a 25 year old company that employs 60 people. They produce engineered textiles for various industries. They have been running at capacity, producing product 24 hours a day, 5 days a week, over 3 shifts. Approximately 40 machines are involved in the production, 30 of which are very similar in function and operation. We selected one group of 7 machines – one row.

Establishing baselines and control conditions:

Company B had a lot of historic production information so we did not have to establish a "control" machine. Their key performance metric was the weight of the product shipped each day. Each roll of product has a specific weight and the production of each roll required a specific time on the machine. They know that their average "uptime" of the machines overall was 82%, and that this number has been consistent for years.

Company A did not have similar production information that could be tied back to machine run-time, and the jobs that need to be performed each day vary greatly. One of the 6 machines selected for the test would be "the control machine"; we would use this machine to give us a comparative baseline for the other 5 machines. Since the only thing we ultimately wanted to deduce was the effect of giving the operator meaningful performance feedback in real time, the control machine was equipped with a small computer and screen that only he could see. One operator, on one machine, would be working with real-time relevant feedback, and 5 wouldn't be.

Company A would clearly provide the biggest challenge. It would require a far longer recording period to establish a reliable pre-deployment baseline. Fortunately, we have had several job shop companies to choose from where we had been collecting basic baseline data.

Equipment and Software involved:

FreePoint installed their FPT 4i remote monitoring unit on each machine in the study at both companies. The FPT 4i is a simple “black box” that has 4 digital inputs and communicates wirelessly with an FPT MS1 master communication device. The MS1 is connected to a simple PC, which runs a small data aggregation program called CellMonitor.

The entire installation was “non-invasive”, meaning that none of the machines, the controls, or the programs needed to be modified in anyway. FreePoint uses their patent pending technology to connect to the machine simply. Similarly, by using wireless communications to the data aggregator, the installations were performed very quickly and non-disruptively.

Summary of equipment for first stage:

FPT 4i remote units mounted on machines in the test, using FreePoint’s non-invasive connections to the machine, and wireless communications to the data aggregator.

FPT MS1 master communication unit to communicate wirelessly with each FPT 4i unit, and transfer the reported information to a PC through USB.

CellMonitor is FreePoint’s proprietary software that manages the wireless network and sorts and stores all the events reported by the FPT 4i remote units. The information is all stored in CSV files sorted by machine, and date and time stamped and stored in chronological order.

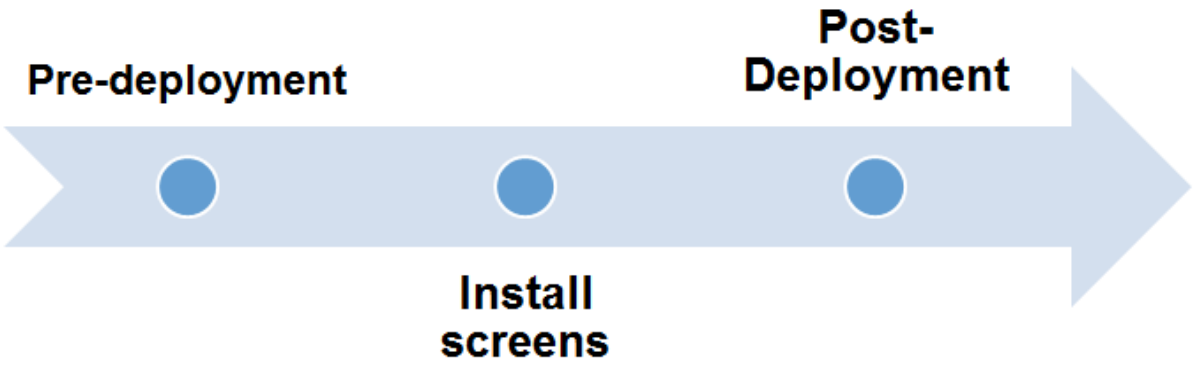
FP Secure is FreePoint’s proprietary software that then pushes the data on the PC to a remote server (our ‘ShiftWorx’ platform) in the cloud. This stage was not absolutely necessary, but having access to all the data remotely and on one server facilitated our analysis. Plus, it added one more level of data redundancy.

Data redundancy:

The FreePoint system provides several levels of redundancy. The FPT 4i boxes each store their own timer and counter functions. If communication is lost for several seconds, or even minutes or hours, the data aggregator is instantly updated with timer and counter information as soon as the connection is restored. (The time stamped information is lost, but the accumulated timers and counters are not). If the data aggregator (CellMonitor) loses connection with the remote server (ShiftWorx), even for multiple days, all the information is filled in and synchronized when the connection is restored.

Our Process:

Our process was simple. At each customer, we would collect data for a sufficient period of time, analyze the data, determine basic KPIs and then build rudimentry display templates to display them. At a selected point, LCD screens would be installed on the plant floor where the operators could see them, and we would then continue to monitor the machines exactly the same way we did before the LCD screens were deployed.



As a side note, the process we followed lines up well with FreePoint's overall product marketing approach – "measure, analyze, share". For the study, we did it as 3 distinct steps over a long period of time. What we encourage manufacturers to do, and what we started doing at the time the screens were deployed, is closing this loop on the plant floor in real-time, every day.

The screen below is an example of the feedback we gave the operators.

Each horizontal bar represents a 24 hour period of time for a particular machine. The

right most side is the current time and the left most is 24 hours ago. The blue periods are the periods of time where “value adding activities” were occuring on the machine. The white represents periods of time where no value adding activity was occurring. In the case of an EDM machine, value adding activity was determined to be any time the electrode wire was feeding. For the CNC machines, it is any time the spindle is under load. For the water jet, it would be any time it is actually cutting.

The boxes on the right are numeric KPI (key performance indicators) that can be easily changed and modified to suit the preference of the people involved. The goal was to give them indications of performance *that is meaningful to them.*

(Many of the features described in general herein are the protected proprietary property of FreePoint Technologies.)

After deployment of the screens, we collected data to compare the results. We also engaged with the operators and supervisors and modified the KPI boxes to suit. We never changed our “blue line” approach, as very early on we noticed a strong focus simply on “keeping the bar blue”. The more the bar was blue, the better the results would be.

The Results:

Company A (the job shop) achieved outstanding results, increasing their “spindle under load time” (which we refer to as “value adding activity time”) by 32%, gaining a total of 6 additional hours and 24 minutes of productivity each day for the 5 machines we studied.

Company B (the steady state manufacturer) improved from 81.8% average uptime to 86% average uptime – a very significant improvement as well. Based on 7200 production minutes available in a standard 5 day week, it results in an extra 300 minutes of winding time per week, per machine, which is roughly 2/3 of a complete shift.

Charts and graphs for the two test companies are attached as an addendum.

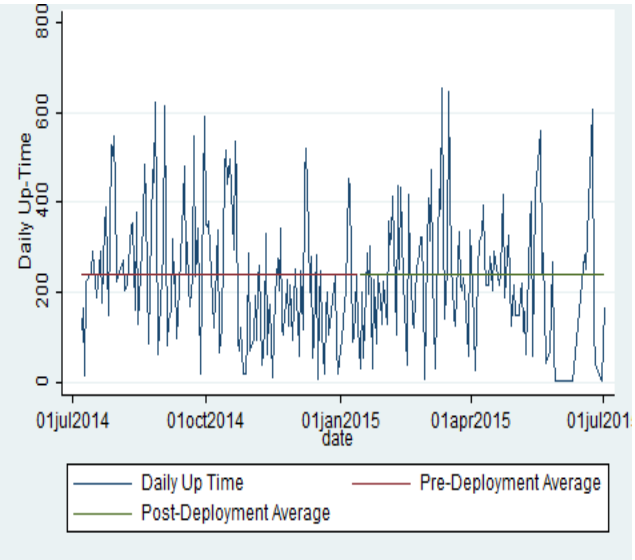
Our Conclusion:

Our conclusion is that by engaging the “value adding people” (the people that run the machines and add value to the product through their direct activities) with meaningful and relevent productivity indicators in real-time will, and does, result in sustained productivity improvement.

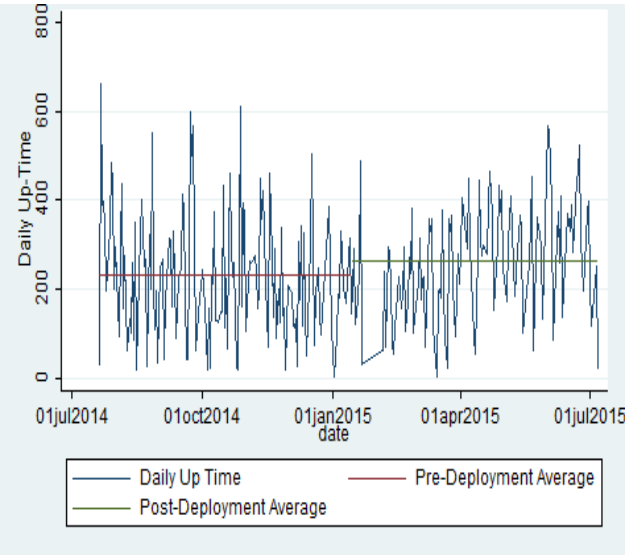
Many companies measure their machine utilization and have plenty of information for management purposes. FreePoint’s position was that there is an opportunity to improve productivity by better engaging the worker with information more meaningful to them. It’s not about more information – its about more meaningful information to more of the people, in real-time.

Company A: 5 Machines plus 1 Control Machine. Job shop operations.

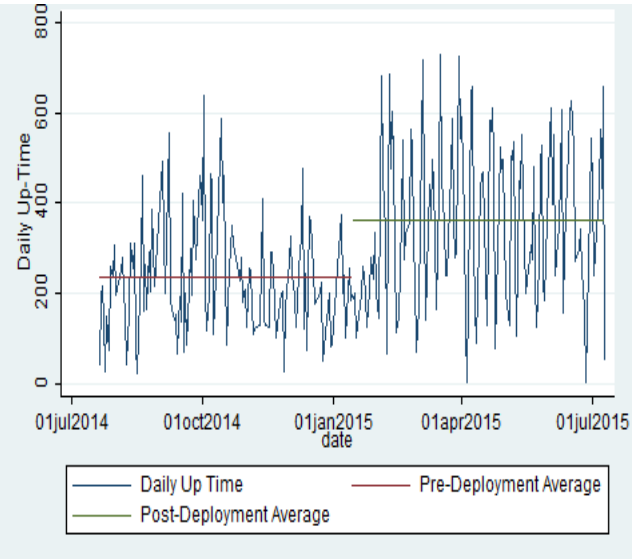
Control Machine – no change observed



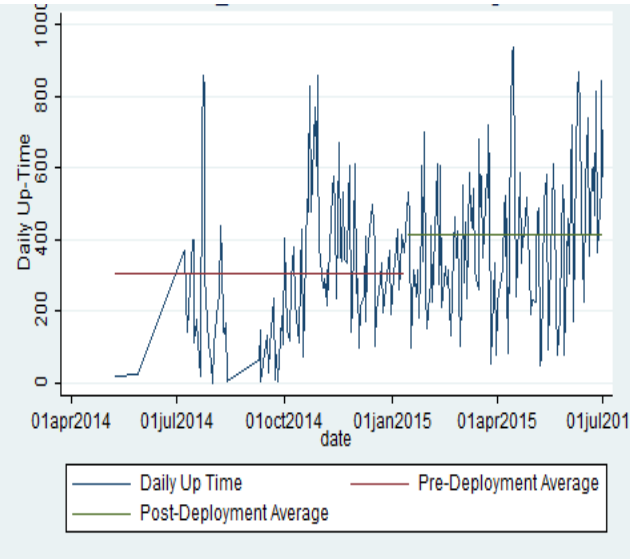
Machine 1 13.7% increase



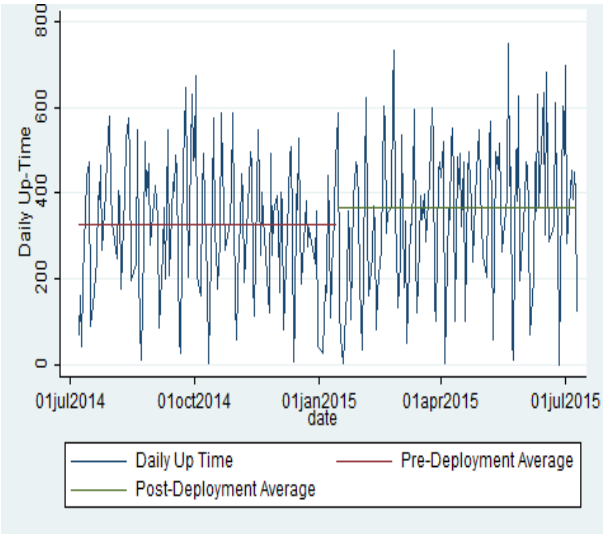
Machine 2 54% increase



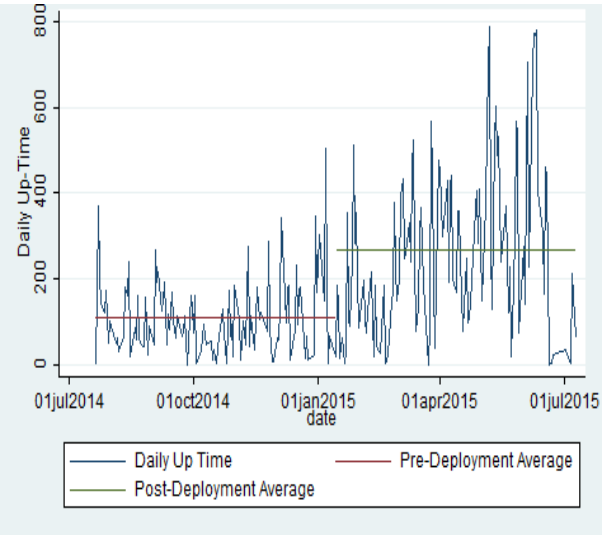
Machine 3 34% increase



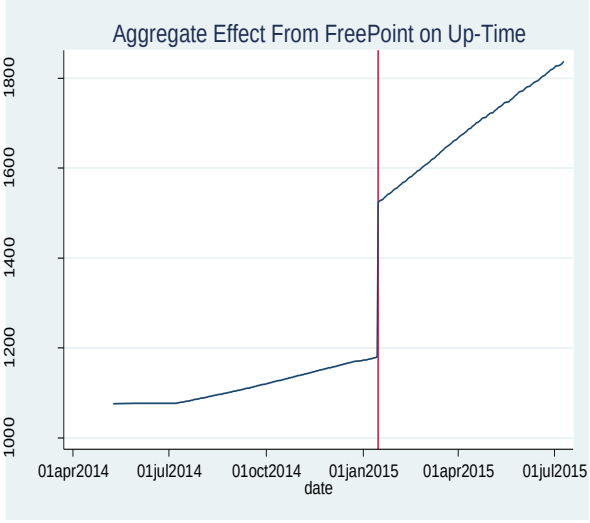
Machine 4 11.5% Increase



Machine 5 145.1% increase



Net Total effect



The over all immediate gain achieved from the 5 machines was 5 hours and 41 minutes of extra productivity time each day, or over an additional hour and 8 minutes for each machine. Post deployment, the productivity gains were not only sustained, they continued to improve an average of 1.6 minutes per pay. At the conclusion of the study, the total gain for the 5 machines had grown to 6 hours and 24 minutes, which represents a total productivity improvement for the 5 machines of 32%.

Company B: 6 Machines, Steady State Manufacturing

Machine	Work Period	Work Count Total	Work Timer Total		
Aug 3rd to 7th		5	Total Mins Run	Total Mins Avail	Uptime
A02	24	432	5666	7200	78.69%
A13	24	410	5721	7200	79.46%
A06	24	405	5741.9	7200	79.75%
A04	24	461	5737.6	7200	79.69%
A01	24	796	5746.2	7200	79.81%
A17	24	674	5779.8	7200	80.28%
A05	24	374	5702.4	7200	79.20%
Aug 10 - 14th		5			
A02	24	407	5443.3	7200	75.60%
A13	24	518	6005.8	7200	83.41%
A06	24	538	5828.8	7200	80.96%
A04	24	489	6026.4	7200	83.70%
A01	24	1007	6007.4	7200	83.44%
A17	24	680	5953.5	7200	82.69%
A05	24	425	5999.5	7200	83.33%
Aug 17 - 21		5			
A02	24	439	6071.7	7200	84.33%
A13	24	459	6151.7	7200	85.44%
A06	24	368	6003.9	7200	83.39%
A04	24	643	6002.7	7200	83.37%
A01	24	1054	5931.3	7200	82.38%
A17	24	976	5269.1	7200	73.18%
A05	24	395	5997.4	7200	83.30%
Aug 24 - 28		5			
A02	24	472	6038.8	7200	83.87%
A13	24	466	5862.4	7200	81.42%
A06	24	378	5980.2	7200	83.06%
A04	24	589	5974.4	7200	82.98%
A01	24	1682	5985.8	7200	83.14%
A17	24	1016	5993.6	7200	83.24%
A05	24	358	6005.2	7200	83.41%
Aug 31 - Sept 4		5			
A02	24	623	5796.1	7200	80.50%
A13	24	564	5767.7	7200	80.11%

A06	24	394	5775.6	7200	80.22%
A04	24	445	5933.6	7200	82.41%
A01	24	1472	5846.5	7200	81.20%
A17	24	977	5693.9	7200	79.08%
A05	24	420	5966	7200	82.86%
Before deployment			**205407.2**	**252000**	**81.51%**
without outliers			200138.1	244800	81.76%
Screens Deployed on Floor - Sept 8th					
Sept 14 - 18		5			
A02	24	646	6128.6	7200	85.12%
A13	24	575	6193.3	7200	86.02%
A06	24	420	6277.8	7200	87.19%
A04	24	572	5687.6	7200	78.99%
A01	24	1234	6247.2	7200	86.77%
A17	24	1239	6138.1	7200	85.25%
A05	24	432	6264.1	7200	87.00%
Sept 21 - 25		5			
A02	24	661	6059.1	7200	84.15%
A13	24	627	5450.5	7200	75.70%
A06	24	408	6275.3	7200	87.16%
A04	24	692	5360.6	7200	74.45%
A01	24	1089	6253.4	7200	86.85%
A17	24	1290	6041.1	7200	83.90%
A05	24	405	5821.9	7200	80.86%
Sept 28 - Oct 2		5			
A02	24	574	6069	7200	84.29%
A13	24	520	6145	7200	85.35%
A06	24	412	6130.8	7200	85.15%
A04	24	529	6105.6	7200	84.80%
A01	24	1034	6097	7200	84.68%
A17	24	1401	6157.2	7200	85.52%
A05	24	384	6152.5	7200	85.45%
Oct 5 - Oct 9		4.66	Friday shift (thanksgiving) missing		
A02	24	466	5812	6710.4	86.61%
A13	24	495	5615.9	6710.4	83.69%
A06	24	313	5883.5	6710.4	87.68%
A04	24	531	5860.4	6710.4	87.33%

A01	24	944	5797.9	6710.4	86.40%
A17	24	767	5761.6	6710.4	85.86%
A05	24	359	5831.4	6710.4	86.90%
Oct 12 - Oct 16		4			
A02	24	364	4849.8	5760	84.20%
A13	24	356	5065.7	5760	87.95%
A06	24	448	4980.7	5760	86.47%
A04	24	308	5035.1	5760	87.41%
A01	24	748	5028.1	5760	87.29%
A17	24	447	4868.3	5760	84.52%
A05	24	246	4991.3	5760	86.65%
Oct 19 - Oct 23		5			
A02	24	405	6254	7200	86.86%
A13	24	388	6255.6	7200	86.88%
A06	24	379	6241.1	7200	86.68%
A04	24	549	6206.5	7200	86.20%
A01	24	1840	6060.1	7200	84.17%
A17	24	526	6279.9	7200	87.22%
A05	24	293	6172.4	7200	85.73%
Oct 26 - Oct 30		5			
A02	24	437	6302.6	7200	87.54%
A13	24	414	6195.8	7200	86.05%
A06	24	359	6390.7	7200	88.76%
A04	24	406	6292.4	7200	87.39%
A01	24	814	6287	7200	87.32%
A17	24	677	6291.3	7200	87.38%
A05	24	307	6323.5	7200	87.83%
After deployment			**289990.3**	**339292.8**	**85.47%**
without outliers			279179.2	324892.8	85.93%

Improvement	4.17%	
Extra time	300.52	per machine per week
Extra time 7 machine	2103.63	7 machines per week