How the Japanese have engendered long run continuous improvement outside of the car industry.

Dr. Stephen M. Foster

Harvington Management Solutions, WR11 8PZ, UK.

Email: sfoster@harvington.org Tel: 07768 415609

1.0 Introduction

1.1 Metrics of Lean

The author has favoured stock turnover as the benchmark of world class manufacturing ever since his return from Japan (Foster, 1996.) Schonberger (2008) confirms "inventory is a telling metric. Lack of inventory is a convenient, close proxy for lean. Anyone looking around a facility and spotting goodly amounts of materials correctly sees the facility as fat, not Lean. When a close check turns up very little inventory, we conclude the opposite. The most common metric for keeping tabs is inventory turnover. By the accountant's definition, this is cost of sales (also called cost of goods sold) from the income statement divided by value of inventory from the balance sheet. In some countries, cost of sales is not normally included in the income statement. In that case, we use the alternative formula, sales revenue divided by value of inventory. That works, because improvement trend, not absolute value is the point" at issue.

Care, however, must also be taken when comparing absolute values between industries because, as a general rule, the stock turn should be higher the fewer processes and the shorter the duration of those processes. It is difficult to achieve a high stock turn in a steel mill where they cast their own molten metal through to providing lots of specialised finishing process machines. Similarly it is relatively easy to have a high stock turn in a factory making spectacles to order ….as there are few processes with short durations (if the lens cutting machines are automated lasers) and the customer expects to receive their unique prescription glasses quickly, so there is unlikely to be any finished stock held.

1.2 Lean performance

There has been a general regression in Lean programmes worldwide. Today, Toyota the creators of the TPS process, have an inventory turnover of only 10 (March 2015) but it was 27.2 in 1989. The take-up of Lean in the West - 25 years after Womack, Jones & Roos (1990) first published their book on Lean – has yet to achieve any significant momentum when measured in practical results rather than hyperbole.

Thankfully, there is an organisation in Japan who are a fine example to us all. This group of companies enthusiastically continue to follow and improve their programmes of Lean. This is a "club" of Japanese companies (each in a different market/industry) officially called the New Production System (NPS) Research society. They are the founders of the Lean movement outside of the car industry in Japan. They use ex-Toyota employee expertise; initially Mr Taichi Ohno was their Supreme Adviser (or "Godfather".)

Little is known about this club and nothing until now has ever been published about their activities, their methods and what has been achieved. This paper will address this issue. Only recently (in the last 12 months) has a website, with an English translation, appeared to provide even some clues as to their existence.

The “club” was formed in October 1981. The author was privileged to visit several of the sites in Japan in the late 1980’s and to learn their methods and to witness their achievements.

2.0 The NPS Research society

2.1 Structure

The intellectual and creative energy which fuels the application of NPS in this organisation originates from a small group of consultants set up in 1981. The group are all from Toyota and had experienced there the revolution in management practices which was TPS. They wanted to apply the technique to other types of Japanese companies and to this end formed a club[1] of interested companies, committed to improvement and jointly funding the consultancy fees. There are no direct competitors so there is generally only one company from each branch of trade or industry.

For 33 years there was very little known about this club. A year ago they finally produced a website in English which details their aims and their membership. “The NPS Kenkyukai (The NPS Research Society) aims to support, contribute to and improve manufacturing businesses in Japan. The Kenkyukai’s members believe that the race and civilization which forget the art of manufacturing is ruined. Therefore, the mission of the NPS Kenkyukai is to pass down the "Monozukurino Shiso"(the Philosophy of Japanese Art of Manufacturing), and to promote the excellent Japanese manufacturers to the posterity in Japan.”

“The New Production System (NPS) is a management philosophy for manufacturing businesses and a method to enhance a corporate vitality, based on the Toyota Production System (TPS), the so-called “just-in-time” system. “Just-in-time” system aims for the total elimination of all “muda” (means “waste” = any activity that consumers resources without creating value for the customer) to achieve the best possible quality, the lowest possible cost and use of resources, and the shortest possible product and delivery lead times.“

“In the late 1970s the founding members of the NPS Kenkyukai realized that the Toyota Motors “Kaizen method” could be implemented, not only to an automobile industry but also to other manufacturing businesses. The five Japanese independent manufacturers in the various industrial fields organized the NPS Kenkyukai to explore better, more efficient management than the TPS.

A core concept of the NPS is arranging all the processes in the production sequence in a single, smooth flow based on the rate of sales. After Mr Taichi Ohno, a founder of the TPS, became a Supreme Adviser to the NPS Kenkyukai, a number of the TPS "Kaizen" professionals (called Practicing Officers) from the Toyota Motors followed him to join

[1] www.nlmetal.com/ir/library/pdf/Annual_Report_2006.pdf NPS (New Production System): The official name of the club is the NPS Research Society. NPS works to enhance operating efficiency by eliminating all waste. The NLM group holds NPS meetings at its 12 sites and is fostering NPS leaders. This is the 1st public reference to the NPS Research Society.

the NPS Kenkyukai to enhance the manufacturing method and management ability for the Japanese independent manufacturers.

The NPS Kenkyukai is a kind of membership society which only allows one Japanese manufacturer from each business field to become a member. Currently 40 companies are members of the NPS Kenkyukai"

The companies are far from all manufacturers. Whilst most are, there is also a printing, web services and corporate disclosure company employing a thousand people; a chain of restaurants; a sink and kitchen design and a confectionary company.

See Table 1 for a list of the companies and Table 2 for a description of some of their activities and associated stock turns.

The NPS Members

1. Oiles Industry Co.
2. Kibun Foods Co.
3. Ogura Industry Co.
4. Ikuyo Corp.
5. Yoga Precision Co.
6. Shinshin Foods Co.
7. Yokogawa Electric Corp.
8. Skylark Co.
9. Ishikawa Gasket Co.
10. Azden Co.
11. Pronexus Corp.
12. Showa-Aztec Co.
13. Nozawa Corp.
14. Noppon Light Metal Corp.
15. Bando Kagaku Co.
16. Asahi Woodtec Co.
17. Shizuki Electric Co.
18. Clean-up Corp.
19. Sinto Industry Co.
20. Kitz Corp.
21. Iwatsuka Confectionary Co.
22. Hanshin Diesel Ltd
23. Mitsui High-Tech, Inc.
24. Murai Co.
25. Shin-Nippon WEX Co.
26. Ito Confectionary Co.
27. Ringer-hut Corp.
28. KVK Corp.
29. Teral Corp.
30. Sanko Co.
31. Zebra Co.
32. JMS Corp.
33. Ishimura-Manseido Co.
34. Shoda Shoyu Co.
35. Shimizu Gokin Works Co.
36. Xeon Medical Co.
37. Kokubu Electric Co.
38. Taiyo Kagaku Co.
39. Katolec Corp.
40. Yamato-Protec Co.

Table 1 NPS Members of the Research Society

Company	Description	Inventory T/O
Pronexus	Printing, web services & corporate disclosure to 3000 Co's. 1000 employees	40
Nozawa Corp.	Manufacturer extruded concrete panels	18
Shizuki Electric Company Inc.	Develops and supplies capacitors and related equipment and facilities; electrical machinery and equipment	13
Yokogawa Electric Corp	Industrial Automation and Control Business, Test and Measurement Business	7
Ikuyo Co	Manufactures and sells automotive parts in Japan	25
Ringer Hut Co	Restaurants	40
Cleanup	Product line is sink cabinets and system kitchens	40
Iwatsuka	Confectionery Co	20

Table 2. NPS Members and respective stock turns

2.2 Kaizen Method

Aluminium manufacturer Nippon Light Metals (NLM) in Japan was one of the earliest adopters of NPS - which is now known as the Lean production system. NLM had joined the NPS Club in 1982, so that by the time the author visited NLM in 1987 they were achieving amazing results at several of their plants including the Kambara smelter and extrusions, Funabashi windows assembly and Nagoya rolled products mill. The author was privileged to spend a lengthy period at these sites in Japan in the late 1980's, to witness their achievements first hand and to be taught their methods.

NLM joined the club[2] around 1982.The senior consultant is called the "Godfather" who leads a team of about 25 who the Japanese call "Instructors". This is not a good translation. Their role is that of a highly respected and authoritative expert. All the "experts" make regular visits to the member companies to advise on the application of NPS and to criticise and assess progress. In the case of NLM the Godfather himself was their visiting expert. He calls at each site at approximately three monthly intervals and without any prior warning.

There is a steering committee of senior policy makers and a working committee, the meetings of the latter are held on member companies' premises and the participants become involved in Kaizen projects on each other's premises. The Club's Kaizens are held approximately every six months for 24 participants and is the main method by which the NPS 'message' is disseminated. The typical programme starts and finishes on a Saturday. (It is jokingly referred to as the 8 day 3 night Kaizen, making the point that it is a very intense activity; you only get 3 nights sleep!). The first two days are in the classroom learning the NPS theory.

The proponents seem to have a knack of thinking up simple but memorable images and words to explain the ideas. "Don't fight gravity", (eliminate unnecessary lifting), "Just in Case is the enemy of Just in Time," "eliminate Pinocchio movement" (Pinocchio movement is a series of straight lines and right angles, jerky, like a puppet such as an overhead crane might follow). "Remove the small stones first" - start by tackling the little obvious problems. The "Piranha" method of tackling a task is when a group of people gather round and "attack" the problem together; like a shoal of Piranha fish attacking a victim. One of the unique strengths of the method is anyone can understand it (but not necessarily accept it!).

It means, however, that the professional and technical specialists, who are largely going to run the implementation, have to have the intellectual humility to see that the simple conceptual framework is what allows the participation of a wide variety of people in the process. To accept this they must recognise that this is ultimately what makes it so effective and be willing to "share" the problems with non-specialists.

After the two days in the class room the participants spend the remaining time on specific improvement projects. They are normally split into three groups of eight each working on a project. This process is very carefully planned. The problem to be attacked is clearly specified and the improvement target and both are written down on a standard form. For example, a project may be aimed at reducing a machine set up time; in which case a precise reduction will be specified as, say from 30 minutes to 15 minutes. This means, of

[2] To the best of my knowledge, what follows must be similar to how Toyota had initially organised their TPS and Kaizen activities in Japan, as these were ex Toyota employees.

course, that quite a lot of preparatory study and measurement is required before the project can start.

The project is always a real one. It follows that the programme is held on one of the Club member's sites. It is an essential characteristic of the method that the participants are required to actually implement the improvement during the six days left to them. Their end product is not a report or recommendation, but the demonstration that the sought improvement has actually happened.

This requires a great deal of work, much of it spent on the shop floor. It is apparent, from the stories one hears about this process, that a very intense level of involvement and activity is generated. Typically, the participants alternate between study of the production process and discussion and analysis in the meeting room, followed by trials of new ideas, which they themselves may conduct out of normal hours. When the solution has been agreed, they will then explain it to the operators, persuade them that it makes sense and help them to make the changes before demonstrating that the targets have been met.

The projects are very carefully chosen and the targets are set by people who understand the particular plant very well and are very experienced in running Kaizen programmes. At the end, the participants disperse to the member companies not just understanding NPS intellectually but having experienced it. (The Japanese put it more poetically; they say you take it into your heart as well as your head.)

At the plant level, the Kaizen process described happens more frequently, and is the concept which focuses all the NPS activity. At Nagoya, for example there were two full time Kaizen staff. They organise a continuous series of project activities at approximately monthly intervals. They are shorter than the 8 day event held by the Club, usually between 2 and 4 days. The participants are drawn from operators, managers and supervisors at the department in which the project lies, plus appropriate specialists such as engineers and metallurgists. Most of the projects are long term ones which are approached step by step and then tackled in these intensive bursts. A lot of pressure is applied to implement the target improvement during the Kaizen period and in some cases this means devising improvised tools and equipment which are subsequently made in more permanent form after the Kaizen is over.

Care is taken to ensure that the improvement obtained is permanent. A standard operating procedure document is written specifying exactly what the new standard is and how it is achieved. These often contain diagrams showing new layouts and how equipment tools and people move around the work area. The line management play the primary role in this system. At Nagoya, the driving force is the works manager and his assistant. Of the two full time Kaizen organisers, one is an ex industrial engineer, and one an ex supervisor. Line managers are expected to spend half their time on improvement activities. In between the intensive Kaizen activity they are expected to be thinking about and planning the next as well as consolidating the previous one.

Of course there are aspects of the system which are especially Japanese. The unique position of the Godfather is probably not transferable in the same form. But what are the real strengths of the Kaizen system? It's pragmatic, it's action oriented, it tackles real problems using a simple conceptual framework which everyone can understand; it mobilizes peoples' intellectual and emotional energy by tackling the work in short intensive bursts. It uses a small group of people who contribute a wide range of different intellectual and professional skills and who become highly committed to each other and

to the project. It gives everyone the satisfaction of seeing real progress in a short time. It's basically a top-down management led approach - Jishuken.

2.3 Achievements at NLM

NLM explained that one of the main reasons for their success in Lean was that they joined the NPS Club and had the influence of the Godfather. No doubt the Godfather helped NLM also to “bend” TPS and to fit metals manufacturing, when it would be all too easy to say “it just doesn’t fit”.

NLM proudly showed off their Funabashi extruded windows assembly operation. Here using “standard” TPS over the 5 period from 1982-1987 they had reduced inventory by 85% increased production by 62% with a labour cost reduction of 38% (redundancies.) They demonstrated to our party an inventory turnover of 80+ and the pace of the operation there was frenetic.

NLM’s Kambara extrusions mill had increased production by 33% with a 75% reduction in inventory over a 12 month period and had an inventory turnover of 30. See Figure 1.

The Kambara smelter had reduced inventory by 56%.

But, for the author, the achievements at Nagoya remained the most impressive of this visit.

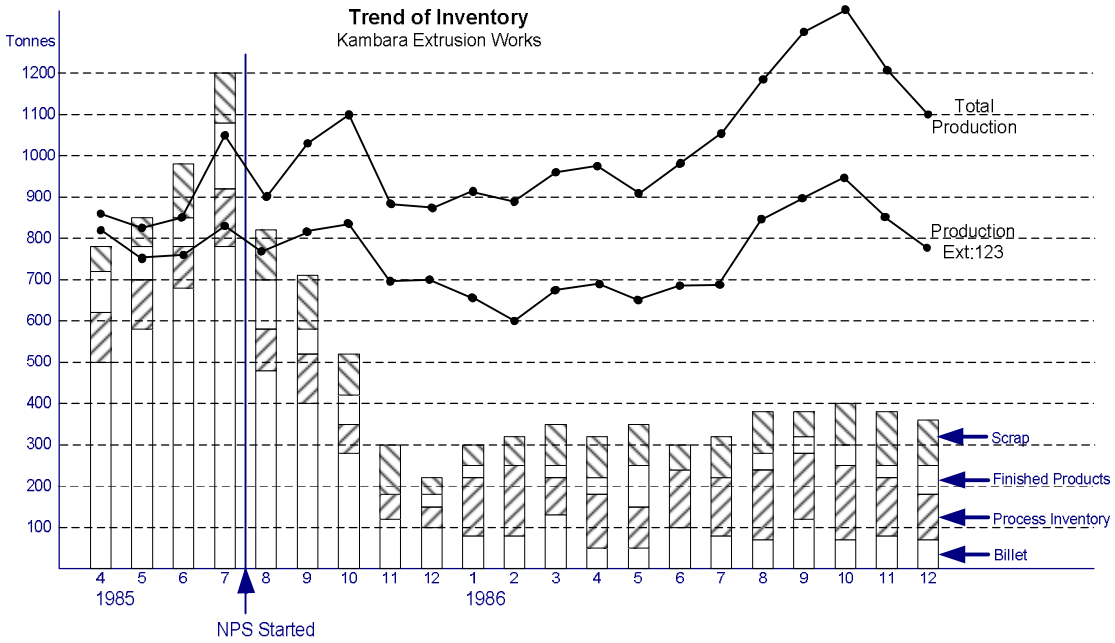

Figure 1 Kambara production and inventory levels – before and after NPS

2.4 Levelled production at Nagoya

A core concept of NPS is arranging all the processes in the production sequence in a single, smooth flow based on the rate of sales.

For those unfamiliar with aluminium sheet production, it is important to realise that most plants, including the Nagoya plant, are not laid out for small flexible production but nevertheless, using an ingenious application of the Lean production system, NLM had achieved it. Figure 2 shows the daily two cycle rolling programme used to achieve it at the hot mill. Their rapid set up change was their key to achieving Heijunka!

Lean "theory" emphasises the "pull" concept of just in time production in which workers are envisaged calling for, or collecting, the item they are going to work on. The ultimate aim is a batch size of one. At Nagoya their approach is to set a limit on the number of items (billets, coils, etc.) that can be produced for, or delivered to, or stored at the next machine centre. This involves some machine centre production to be synchronised, for example scalping and soaking pits. Where possible they scalp warm ingots to save energy. Under any scenario they cannot have more than one soaking pit load ready at a time; if necessary scalping is stopped. One consequence of the method is that workers are sometimes idle because the quota is (temporarily) fulfilled. This time is used for housekeeping and machine maintenance. The standard of housekeeping – known as 5S - was very high indeed at all the NLM plants visited. 5S is not just a consequence of idle time, however; if necessary, overtime is devoted to it.

Workers are also very versatile and their pay reflects how many different jobs they can do. If necessary they can be easily transferred to the place they are needed.

The improvements they have made enabled them to save some labour but this is not a high priority. At the hot line (which includes the soaking pits) the crew has been reduced from 9 to 7. This crew of 7 change the work rolls in under 10 minutes[3] (reduced from a starting point of 2 hours.)

[3] NLM's work roll change truly represents SMED (single minute exchange of dies) at its very best. As a comparison, Alcan's Rogerstone sheet mill at that time was achieving a stock turn of 12 and the Kitts Green plate mill a stock turn of 4 ; it took a weekend (on overtime) to change the work rolls on the mills.

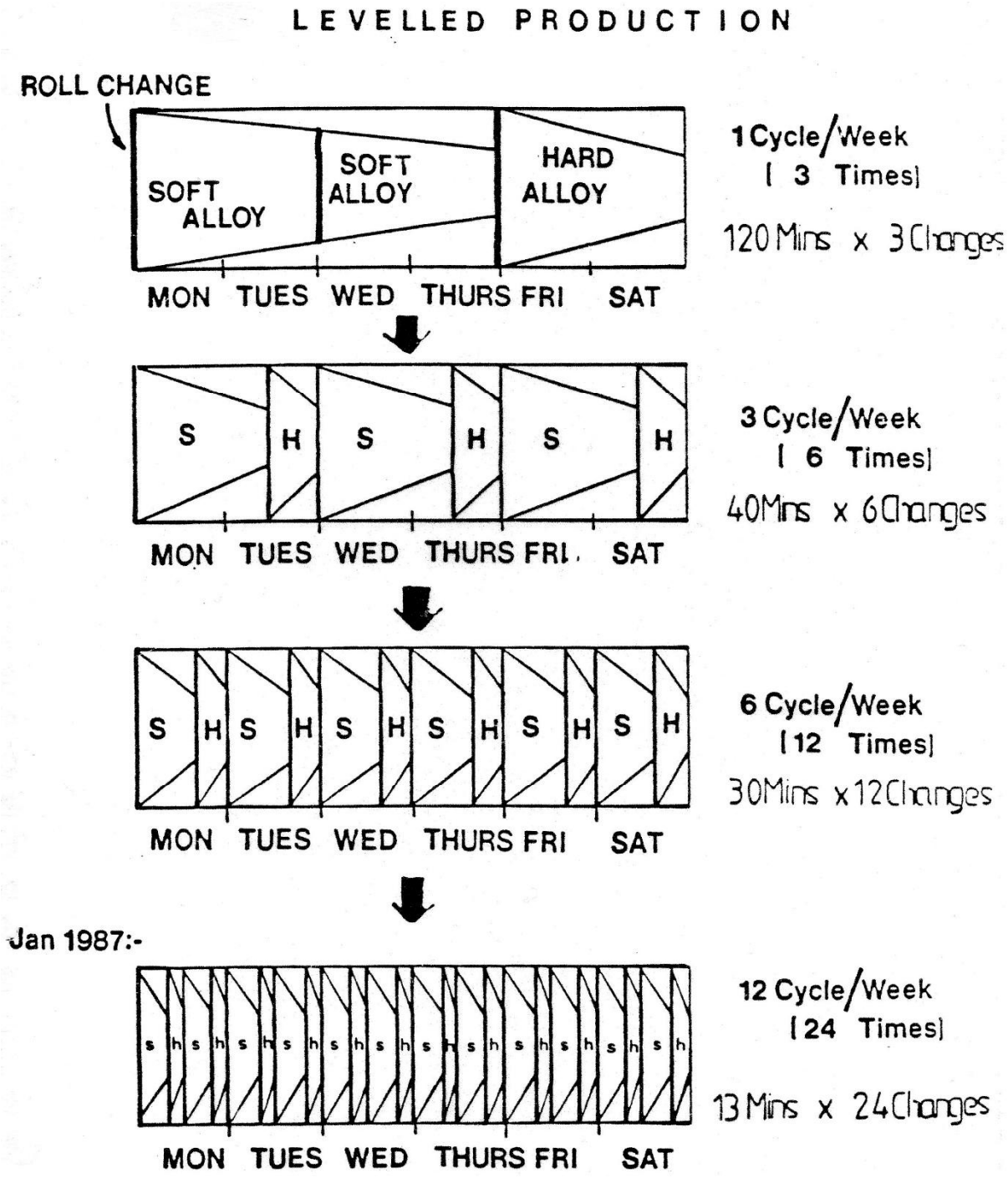

Figure 2 Roll change SMED and daily cycle

As a consequence the manufacturing elapsed time through the Nagoya plant (production lead time) had been reduced from 19 (calendar) days to 6.6 days. Inventory was reduced by 55%. Coils were force cooled at many locations to reduce inter-process waiting time. The methods used were cheap and fairly primitive and engineered in-house. An important benefit of the short production lead times is substantially improved quality arising because problems are detected much quicker. It also leads to substantially improved certainty of achieving the output targets. If work in progress has been cleared because of a

machine breakdown, finished material starts to appear very quickly as soon as the breakdown is put right. At Nagoya there are fewer shortfalls in production output than before NPS was introduced. Whilst the financial benefit of the reduced working capital (on inventory) is an important benefit, the improved quality, productivity and customer service are the greatest benefit of employing NPS.

2.5 Other members of the NPS club

The companies in the NPS Research Society cover a diverse range of industries and are by no means all manufacturers. They include 2 restaurant chains, a kitchen design company, a confectionary company, a legal corporate disclosure organisation and others. Table 3 lists some of the companies, their activities and their respective inventory turns.

Table 3

NPS Members

Company	**Description**	**Inventory T/O**
Pronexus	Printing, web services & corporate disclosure to 3000 Co's. 1000 employees	40
Nozawa Corp.	Manufacturer extruded concrete panels	18
Shizuki Electric Company Inc.	Develops and supplies capacitors and related equipment and facilities; electrical machinery and equipment	13
Yokogawa Electric Corp	Industrial Automation and Control Business, Test and Measurement Business	7
Ikuyo Co	Manufactures and sells automotive parts in Japan	25
Ringer Hut Co	Restaurants	40
Cleanup	Product line is sink cabinets and system kitchens	40
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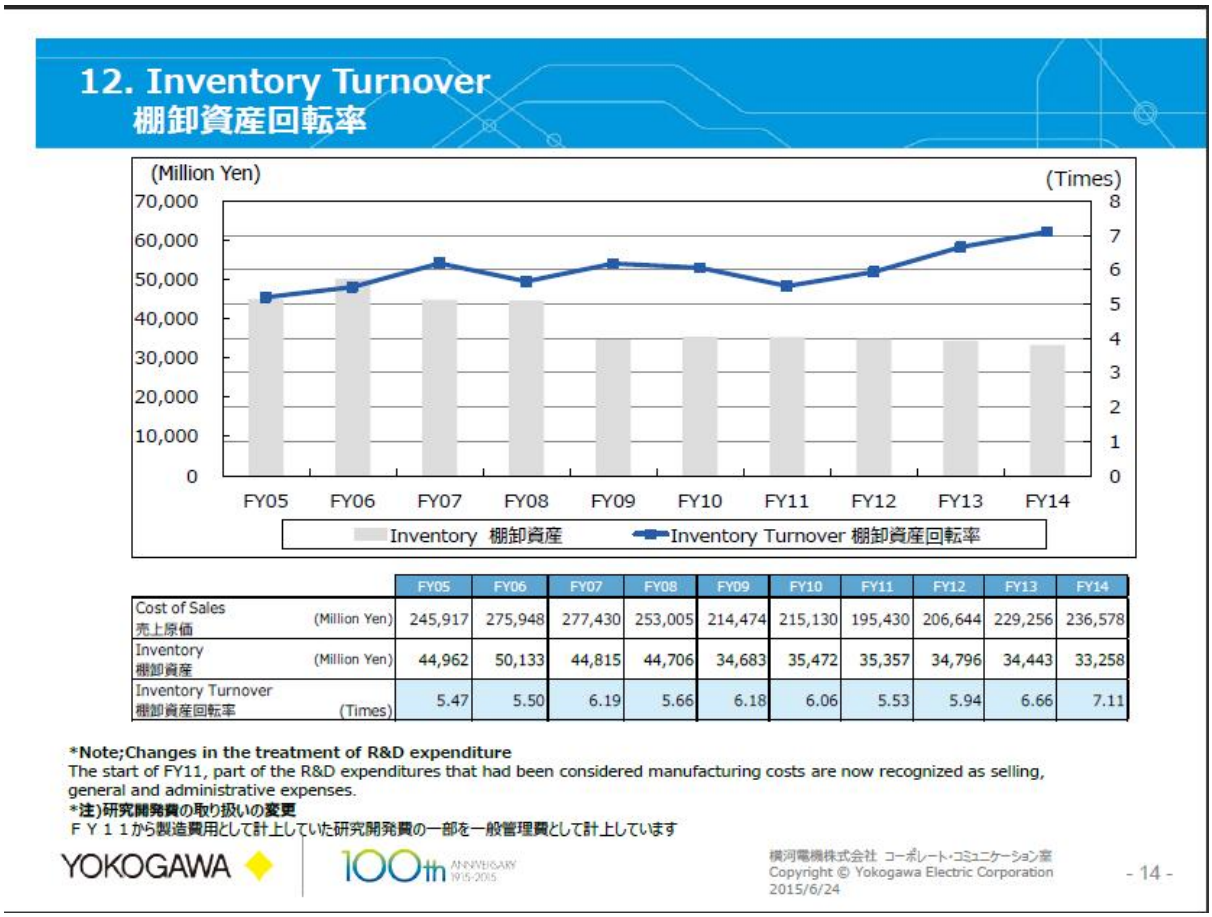
In continuous improvement, the Yokogawa Electric Corporation has improved its inventory turnover year after year and the fact that in their annual report they include a chart of inventory turnover shows that this metric is incorporated into their business strategy as one of their key KPI's. See Figure 3



		FY05	FY06	FY07	FY08	FY09	FY10	FY11	FY12	FY13	FY14
Cost of Sales 売上原価	(Million Yen)	245,917	275,948	277,430	253,005	214,474	215,130	195,430	206,644	229,256	236,578
Inventory 棚卸資産	(Million Yen)	44,962	50,133	44,815	44,706	34,683	35,472	35,357	34,796	34,443	33,258
Inventory Turnover 棚卸資産回転率	(Times)	5.47	5.50	6.19	5.66	6.18	6.06	5.53	5.94	6.66	7.11

Figure 3 Yokogawa Electric Corporation inventory turnover

Whilst this represents a far from spectacular performance it is evidence of an NPS programme in action.

The Ikuyo Corporation manufactures and sells automotive parts in Japan and has a stock turn that has risen from 19 to 25. Compare this with the performance of Delphi in the UK, who have a static stock turn of 12.5. See Table 4. Also compare the Yokogawa Electric Corporation with Alstrom or General Electric. Also look at Thorntons confectionary business turnover in the UK in Table 4.

Table 4

INVENTORY TURNOVER

FINANCIAL YEAR										
Ikuyo Co	X	X	X	03/09	03/10	03/11	03/12	03/13	03/14	03/15
				19.40	15.68	21.36	21.66	21.15	22.20	25.49
Delphi Automotive Plc	X	X	X	X	X	12/10	12/11	12/12	12/13	12/14
						12.63	13.11	12.13	12.57	12.61
Yokogawa Electric Co	FY05	FY06	FY07	FY08	FY09	FY10	FY11	FY12	FY13	FY14
	5.47	5.50	6.19	5.66	6.18	6.06	5.53	5.94	6.66	7.11
Alstrom SA		03/07	03/08	03/09	03/10	03/11	03/12	03/13	03/14	03/15
		7.11	6.74	5.86	5.41	5.3	4.87	5.2	1.57	2.76
General Electric		12/06	12/07	12/08	12/09	12/10	12/11	12/12	12/13	12/14
		6.51	6.38	6.31	5.92	6.1	5.39	5.1	4.72	4.64
Thorntons Plc	06/05	06/06	06/07	06/08	06/09	06/10	06/11	06/12	06/13	06/14
	4.96	5.16	5.31	4.82	4.03	3.69	3.63	3.17	3.22	2.96
Kerry Foods	X	X	12/07	12/08	12/09	12/10	12/11	12/12	12/13	12/14
			6.05	6.02	5.97	5.79	5.27	8.16	8.08	7.54
Ringer Hut Co.	X	X	X	X	02/10	02/11	02/12	02/13	02/14	02/15
					31.00	36.03	31.93	30.50	34.33	38.04
Shimizu Corp.	03/06	03/07	03/08	03/09	03/10	03/11	03/12	03/13	03/14	03/15
	2.36	2.37	2.29	2.63	2.95	4.01	5.92	9.97	17.34	18.11

3.0 Is there scope for a Lean Club in the UK?

Whilst there are pockets of excellence in western organisations, and it is still a hot topic, the Lean initiative has never really taken off as it should. An examination of the inventory stock turns of major corporations makes for grim reading. The barriers to Lean implementation discussed in “Where is Lean today? Benefits, barriers, deployment and future?” (Foster 2015) will outline some of the reasons why.

In order to address part of these barriers, note that the NPS club in Japan insist that “the CEO of the company wishing to join the society should be sympathetic to the NPS Management Philosophy.”

The UK is currently trying to rebuild its manufacturing base and apprenticeship schemes are flourishing. It is very sad that the UK has little or no aluminium, steel, textile, motorbike, electrical goods any many other types of manufacturing industries. There is no reason why they should not! Companies are starting to re-shore. Labour prices across the world will equalise. There are benefits attached to JIT sourcing from ‘local’ companies.

When the author joined Alcan Aluminium UK Ltd in the late 1970's the company employed 10,000 people in smelting but largely in manufacturing semi-fabricating aluminium products, such as sheet, extrusions and foil. The Lynemouth smelter set up under the Harold Wilson government closed in 2010 and the Rogerstone sheet mill, employing 2000 workers in 1970 was closed in 2009, with the equipment later transferred to India where it is used to supply one of the fastest growing markets in the world (the aluminium sheet market.) Whilst we cannot turn back the clock… the opportunity nevertheless exists for any manufacturer who adopts Lean manufacturing methods in whatever industry to scoop the pool (monopolise the market.)

This would be best facilitated by the creation of a recognised non-profit making organisation where the Lean facilitators and experts in that organisation are funded by the companies striving for continuous improvement, as they are in the NPS Research Society in Japan. It would make most sense to include a wide range of organisations (as they do in Japan) to include healthcare, retail, service, financial, logistics and so on.

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