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e-book: Towards Lean Manufacturing - the Kanban Method
February 2010

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Dear e-Participant,

Welcome to this e-Course! I am confident you will find it of interest and beneficial.

To begin with, a quick presentation: I am Carlo Scodanibbio, Italian, Engineer, graduated in 1970, and with over 39 years of post-graduate experience in Project Engineering, Plant Engineering, Project Management, Industrial Engineering and Operations Management Consulting. I have been a free-lance Industrial Consultant for the past 30 years, and a HR Trainer for the past 20.

My field of activity is: World Class Performance in the Small and Medium Enterprises. I have operated in several Countries, including Italy, Romania, Malta, Turkey, Cyprus, Lebanon, Cape Verde, Kenya, Mauritius, Malaysia, India, Saudi Arabia, South Africa and neighbouring Countries.

My “real-world” training style is very interactive. I am afraid this won’t be possible in the case of an e-Course, such as this one.

And yet, as a participant in this e-Course, you are entitled to contact me for clarifications or further explanations with regard to the topics of this Course. You may do so by e-mail: mail@scodanibbio.com

And now let’s start.
The title of this Course is:

“Towards Lean Manufacturing: the Kanban Method”

Today’s state-of-the-art discipline for the Manufacturing Industry is **Lean Manufacturing**.

Lean Manufacturing is “lean” because it is synonymous with “waste-less” manufacturing, or manufacturing with no waste, where waste is the “fat” in the operational process. When we organise our Sunday barbecue we generally select an assortment of meats, lean and not so-lean: lamb chops, pork chops, spare ribs, sausages and the like contain some fat. Fat gives the “flavour” and the “taste” to a good barbecue.

When it comes to work (manufacturing operations), we do not like any fat, or waste, at all.

A manufacturing process should “flow”, continuously, regularly: the flow of materials should be as linear as possible, without turbulence, without hiccups, without “stops” in the flow, without “back-flow” and so on.

Waste causes turbulence in the flow, and stops, hiccups, back-flows etc.
The way to kill waste is Lean Manufacturing.

“Lean Manufacturing uses less of everything compared with mass production: half the human effort in the factory, half the manufacturing floor space, half the investment in tools, half the engineering hours to develop a new product in half the time. Also it requires keeping far less than half the needed inventory and results in fewer defects...” [James P Womack – Daniel T Jones – Daniel Roos - (The machine that changed the world)]

Many Manufacturing Enterprises are willing to undergo the "lean" road. Many enterprises make a formal decision in this respect.

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Towards Lean Manufacturing: the Kanban Method

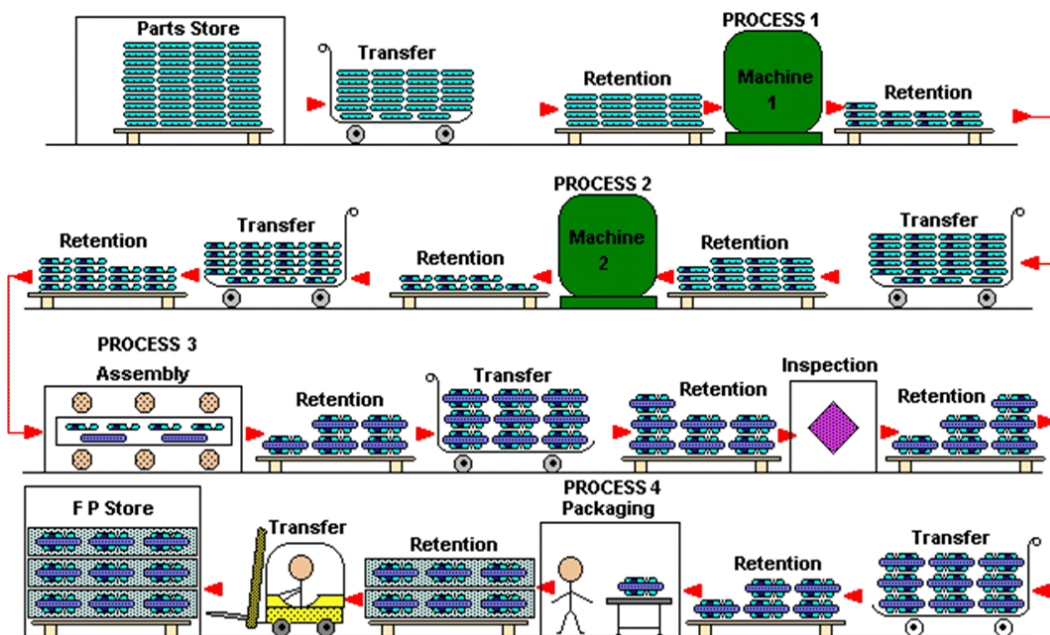
And now:

PRODUCTIVE “STYLES”

Let’s consider a typical Manufacturing situation, with production organised per “lots” (Batch Production) like in any “traditional” factory:

TRADITIONAL “LOT” MANUFACTURING

traditional "lot" manufacturing



MANUFACTURING = Flow of Materials

Main components of Flow: **RETENTION – TRANSFER – PROCESSING – INSPECTION**

In the example:

Retention points: 12 (of which 10 in-process)

Transfers: 6

Processing Points: 4

Inspection: 1

which flow component is “devouring” lead-time??

Processing is normally very fast: in the majority of cases value-adding activities take minutes, if not seconds. Shortening the Processing Time (for instance with faster machinery) will not improve considerably the lead-time...

Traditional “Lot” Manufacturing is much more than just Processing (Value-Adding), which may represent a tiny fraction of the whole undertaking. And when materials are not being processed, lead time is still flowing....

And **the longer the lead-time, the larger the WIP** (Work-in-Process)...

Now let’s consider two main productive methods: **PUSH** and **PULL**.

“PUSH” AND “PULL” PRODUCTION METHODS

<i>Push</i>	<i>Pull</i>
Work-pieces manufactured by “previous process” are transferred to “next process” irrespective of its readiness to receive and process them.	Next process “orders” from previous process “just” what, when and in the quantity it needs.
Flow of Information and Flow of Materials are different. Tools. The required tools are: Volume Planning – Material Requirement Planning (MRP1) – Manufacturing Resources Planning (MRP2) – or the more modern ERP (Enterprise Resource Planning).	Flow of Information and Flow of Material are “parallel”. Nothing takes place upstream unless something is taking/has taken place downstream.
“Independent Process Production” (each Processing Station follows its own schedule, independently of all other Processing Stations).	“Next-Process Dependent Production.
Not flexible at all to changes in production schedules.	Extremely flexible to changes in production schedules.
P-TIME > D-TIME	P-TIME <= D-TIME

- **Continuous Flow** (all situations that allow it – CM and OM)
- **Kanban** (all situations – CM and combination OM/CM)
- **Paced Withdrawal** (narrow variety of products along the same processing line - CM only)
- **Heijunka Box/Runner system** (large variety of products along the same processing line – CM only)

PACED WITHDRAWAL

System for moving small batches of product from one Processing Station to the next at time intervals equal to the pitch (or a small multiple of it).

The pitch determines the frequency with which containers are released from Processing Station to Processing Station and eventually to shipping.

Very well. Now I have prepared the ground. We can now tackle

the Kanban Method

The Kanban Method is a **Pull-style re-ordering system** by which a downstream process requests goods from an upstream process.

The request is by means of a re-ordering Tag (called, in Japanese, **kanban**).

The method may be extended to the entire manufacturing process or only to part of it.







It is normally applied to repetitive operations, both in Catalogue Manufacturing and in Contract Manufacturing.

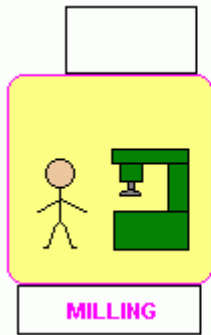
To explain the method, let me give you a simple

example

Let's consider a very simple situation.

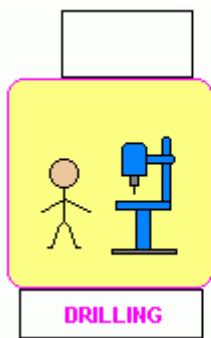
We produce only 2 products, let's call them Product A and Product B.

PRODUCT	ASPECT	Consists of:	Components:
A		A common grey base-plate (Component 2) + a blue top (Component 1)	 Component 2  Component 1
B		A common grey base-plate (Component 2) + a red top (Component 3)	 Component 2  Component 3




Component 2

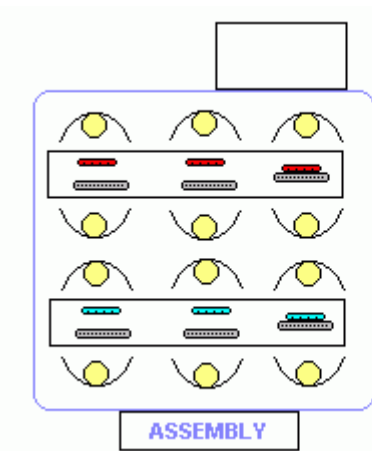
The common base-plate (Component 2) is manufactured in a Milling process




Component 1

Component 3

The two tops (blue – component 1; and red – component 2) are produced in a Drilling process



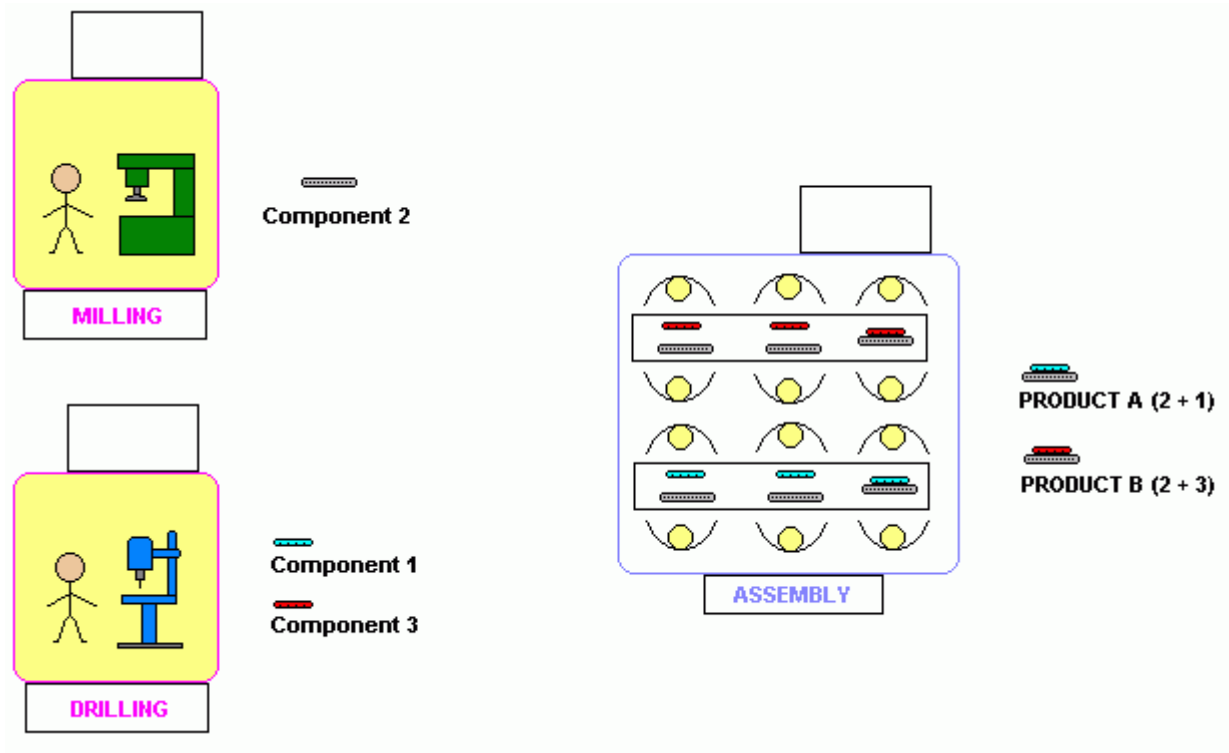

PRODUCT A (2 + 1)


PRODUCT B (2 + 3)

Products A and B are then assembled in a Final Assembly department: here there are two dedicated assembly lines, one for Product A and the other for Product B.

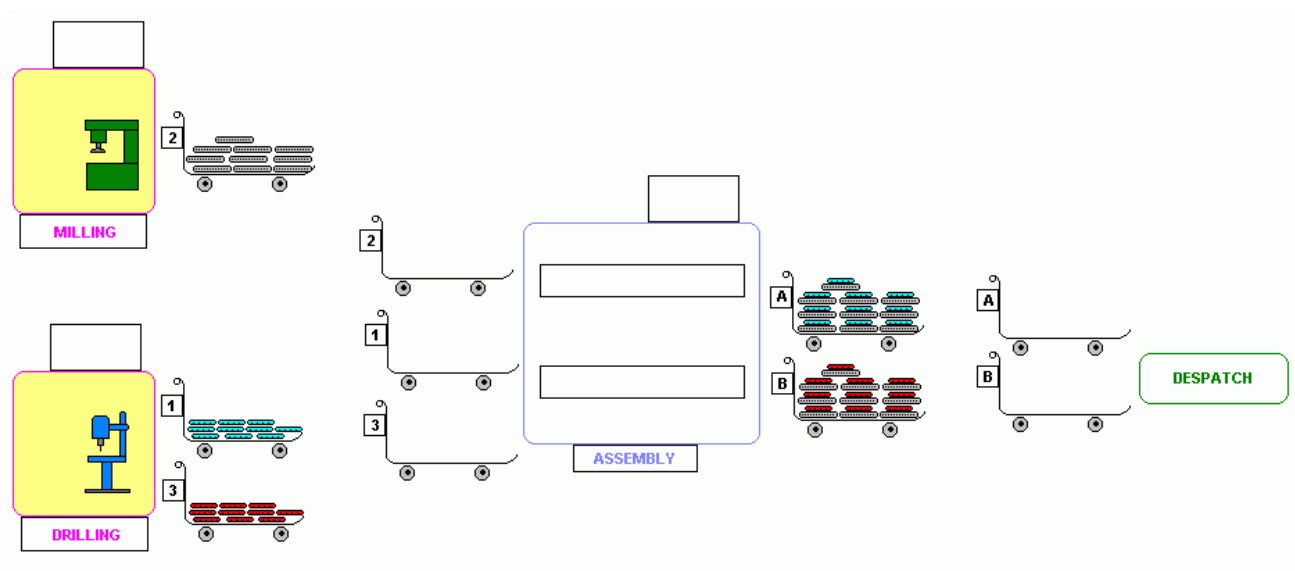
The example is extremely simple, on purpose.

Now let's have a look at this mini-factory layout. Here it is:



Obviously there is some space between machining (Milling and Drilling) and Assembly.

Now let's consider the situation at time 0:



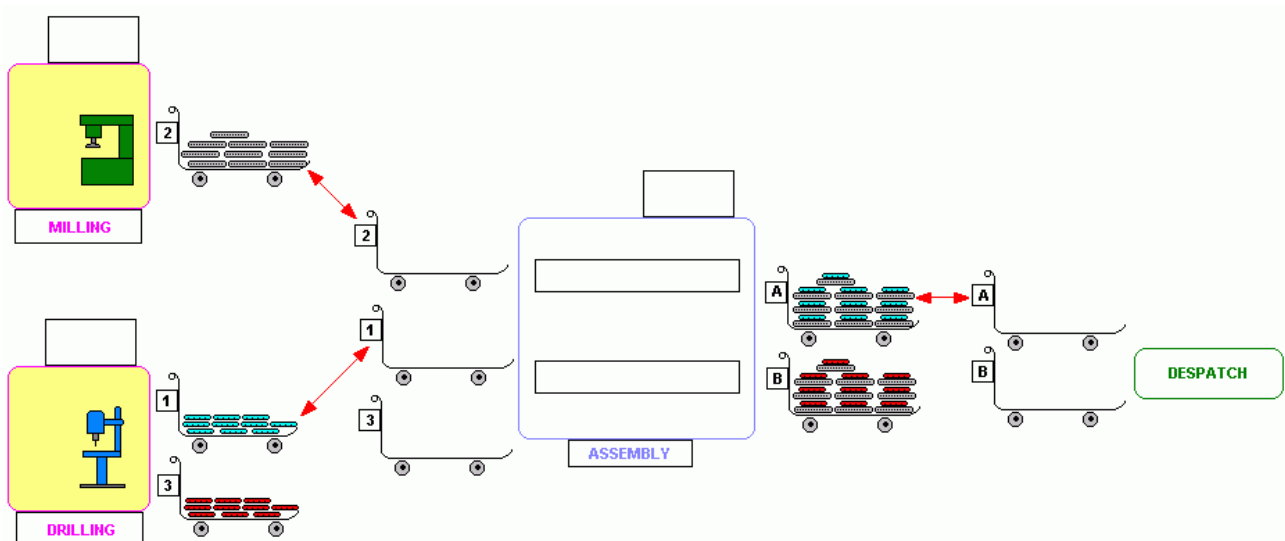
Starting from the left:

- There is a trolley full of Components 2 (grey base-plate) next to Milling. The trolley actually is not full: there are, all together 10 pieces. This is called the “**base quantity**”. The trolley has a **tag** attached to it, showing that it contains Components type 2.
- There are two trolleys containing – respectively – a **base quantity** (10 pieces) of Component 1 (blue top) and of Component 3 (red top) next to Drilling. Each trolley shows the respective **tag**.
- There are 3 empty trolleys next to Assembly (left side: input side), each dedicated to one component (1 – 2 – 3), as displayed by the **tag** attached to each trolley.
- And there are 2 trolleys next to Assembly (right side: output side) containing – respectively – a **base quantity** (10 pieces) of assembled Product A and of assembled Product B, as shown by the respective **tag**.
- Further to the right, we have the Despatch Area. On its left side (input side) there 2 empty trolleys, each dedicated to one product (A – B), as shown by the respective **tag**.

The above is the situation at time 0. There is no action anywhere.

Now, suddenly, something happens: an order for Product A (10 pieces ordered) placed by a Client is received.

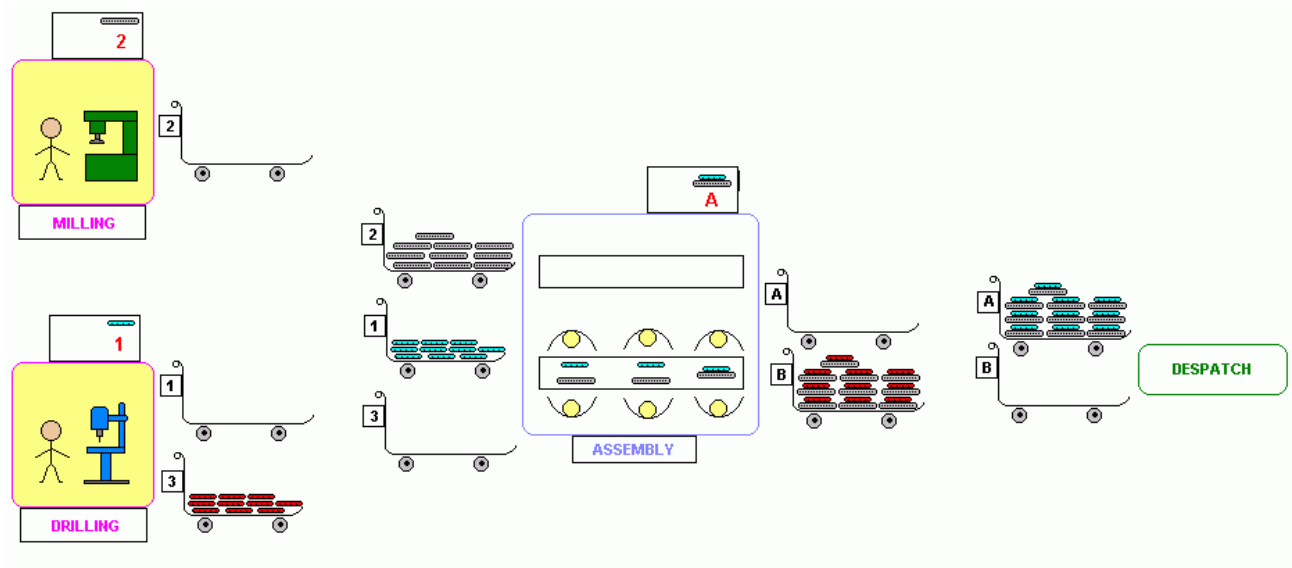
Immediately, a flow of information takes place: details of the order are transmitted to Despatch, AND – simultaneously – to Assembly, Milling and Drilling. All departments know that something has happened downstream (an order has been received), therefore something must be done upstream.



Immediately:

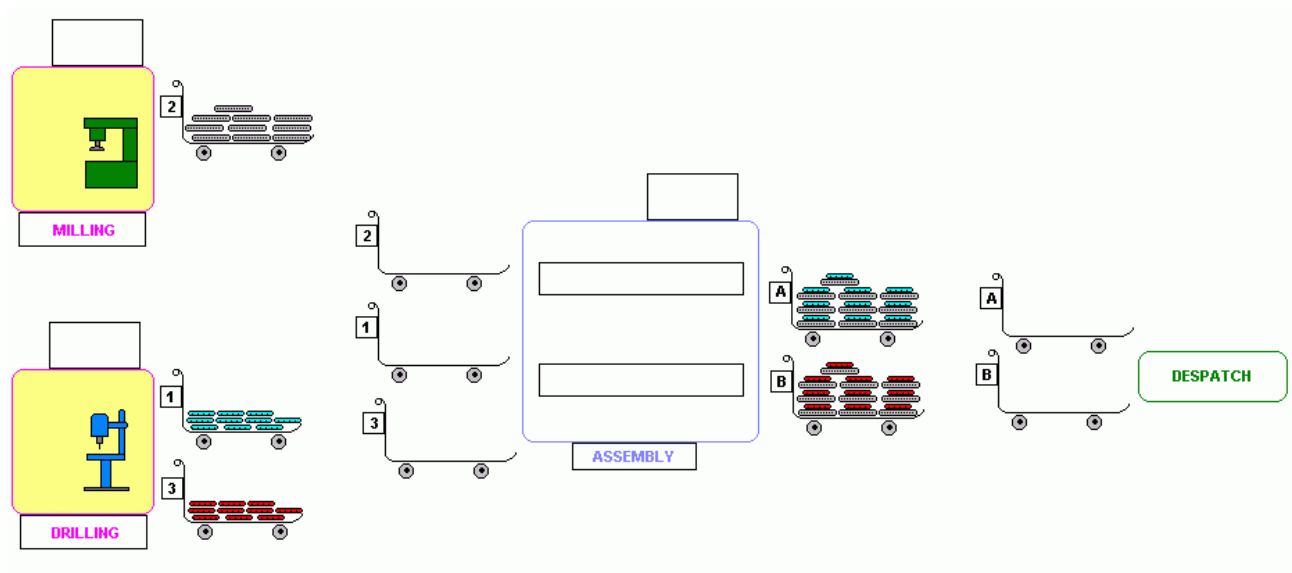
- Full trolley of Product A next to Assembly and empty trolley of Product A next to Despatch are exchanged (swopped). Despatch may now carry on with the delivery of this order.
- Full trolley of Component 2 (grey base-plate) next to Milling is exchanged with empty trolley of Component 2 next to Assembly.
- Full trolley of Component 1 (blue top) next to Drilling is exchanged with the corresponding empty trolley next to Assembly.
- Now it's time for everybody to get in action.

In the next flash we see:



- That Dispatch is ready to deliver 10 pieces of Product A
- That Product A Assembly Line is now going into action to replenish the Product A empty trolley with assembled Product. People there start assembling. A **tag** shows that Product A is being assembled.
- Milling worker now starts producing grey base-plates (Component 2) to refill the corresponding empty trolley. A **tag** shows what is being produced.
- Drilling worker now starts producing blue tops (Component 1) to refill the corresponding empty trolley. A **tag** shows what is being produced.

After a while the work has been completed:



- Dispatch has delivered
- Assembly has assembled Product A
- Milling has produced grey base-plates
- Drilling has produced blue tops
- All trolleys "**base quantities**" have been replenished, and we are now back to the original situation.

the kanban method - benefits

The main ones:

- ❖ **Stock** and **WIP** can be accurately measured and known at a glance. This is intrinsic in the kanban system. Having assessed and based our production on **base-quantities**, at any moment in time *stock* and *wip* can only be so much: we don't even need to count full containers (even if we do it for good practice). The only inaccuracy can derive from a production schedule that has not been completed at a certain processing station (the "mid-way-through" situation). Apart from that, stock is simply known! This is a remarkable benefit, extremely hard to achieve in a PUSH/MRP type of production system (in which we often need to take a full inventory in order to know where we stand.....)
- ❖ **Overproduction** is eliminated - or at least controlled. Overproduction is evil in a PUSH/MRP system: not being based primarily on market demand, it may lead (because of mistaken forecasts on demand) to excessive stocks lying everywhere in the factory (or in the finished product warehouse) and even to obsolescence! This should not happen in a well-orchestrated Kanban system, based on "in-real-time" market demand. Yet, it may happen. Excessive *base-quantities* may lead to overproduction. Sudden variation in market demand may also lead to un-justified *stock* and *wip*. Obsolescence may still take place. But all these negative phenomena can be kept under control in a much easier way.
- ❖ **Production Planning** based on the Kanban Method is easier. Because of its nature: in the perfect Kanban system (utopia!!!!) all is based on customers' orders "on hand". Orders received trigger production planning at the most downstream processing station and simultaneously at all other upstream stations concerned. If the system is well conceived, production schedules are produced in a ziff. This is purely theoretical, though. As soon as the range of products is rather large, and the number of components/parts for each product is also considerable – AND, if there are common parts/components for several products (like the grey base-plate in my example above), production planning becomes tougher. Moreover: sudden variations in demand, or conflicting priorities on despatches of finished products, may lead to some havoc and even chaos. However, compared to a traditional PUSH/MRP system, Kanban production planning is always much, much easier!

As you may easily see, for every benefit introduced by the Kanban Method there may be some corresponding draw-backs. So, let's be a bit more negative now, and make some remarks.

the kanban method - remarks

I could make dozens of them. I will make only a few:

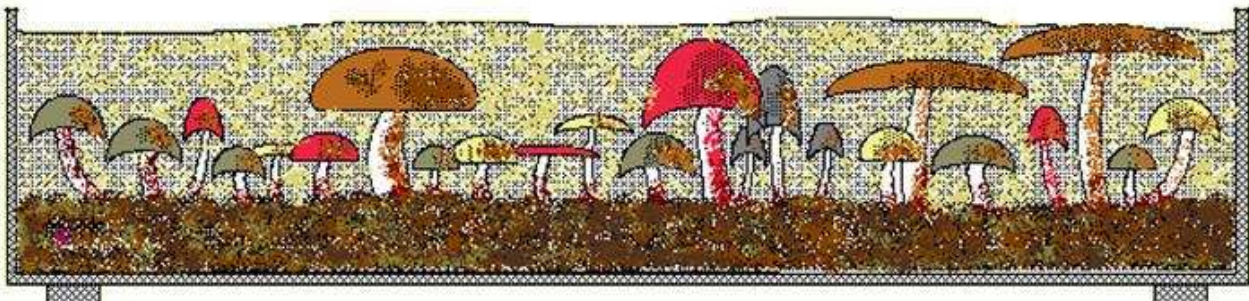
- ❖ Again on **Production Planning**. We must be realistic and consider: non-conformities - equipment losses - set-ups – any other possible hiccup (power failures – absenteeism – etc.). Let's analyse their impact.

- ❖ So, I strongly disagree with many Lean gurus, who state that **there is no Lean Manufacturing without Kanban, and Kanban is actually lean**. I think very differently. **A Kanban Production system is not lean – not at all. BUT, it may help considerably in the road to Lean!!**
- ❖ How? By **representing an intermediate step in the road to lean**, and by showing what must still be done to get there. Haw, that’s interesting! It’s what I call

“intelligent” Kanban

- ❖ Let’s go back to the beginning, when I was saying that many attempts to get to Lean fail, for a number of reasons. Do you remember? I was saying: “....there is another reason why the Lean Project may fail: this is because what is missing is a “**gradual**” approach. That’s where Kanban can help remarkably! Imagine, once more, a very traditional factory, operating **PUSH/MRP/LARGE-LOTS**. If you try to establish lean practices there in one go, you close that factory in three weeks: bankrupt. BUT, **if you start your lean road by gradually instilling and enforcing a PULL type of production, with large-as-necessary base-quantities** (even excessive), and you start from downstream (Despatch areas) – gradually, gradually, gradually it will work. The system will be all but lean – but it starts getting **PULL**. Now you maintain the PULL achievements over a reasonable period of time (months – maybe one year) – until you are sure it is operating well. Now you are getting somewhere.
- ❖ The next step, very gradually again, is to **start reducing the base-quantities**. On purpose. Step-by-step. What will then happen? The more you decrease the base-quantities, the more the inefficiencies (waste) inherent in the existing production system will start surfacing and showing clearly! Now the **awareness-generation stage** begins. People see the waste: the impact of non-conformities – the impact of machine-related losses – the impact of set-up/s and change-over/s – the effect of unforeseen/s of any nature. **Large base-quantities** (large levels of stock and wip) cover-up the waste – smaller base-quantities reveal the waste.

In traditional factories, we treat **waste** like mushrooms in a mushroom-box: covered up with manure!



Manure makes mushrooms grow – manure is the fertiliser. To prevent mushrooms from sticking out, there is only one way: add more manure. Mushrooms will grow very well in the dark, under manure.....

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Well, the same phenomenon happens with **waste** in a traditional factory: we don't like to see it, we prefer to close a blind eye on it... so we cover it up with **stock** and **wip**!

Unfortunately **stock** and **wip** act exactly like manure in a mushroom-box: they make **waste** grow even more! It's a vicious circle from which it's almost impossible to get out...

And consider also the following example:

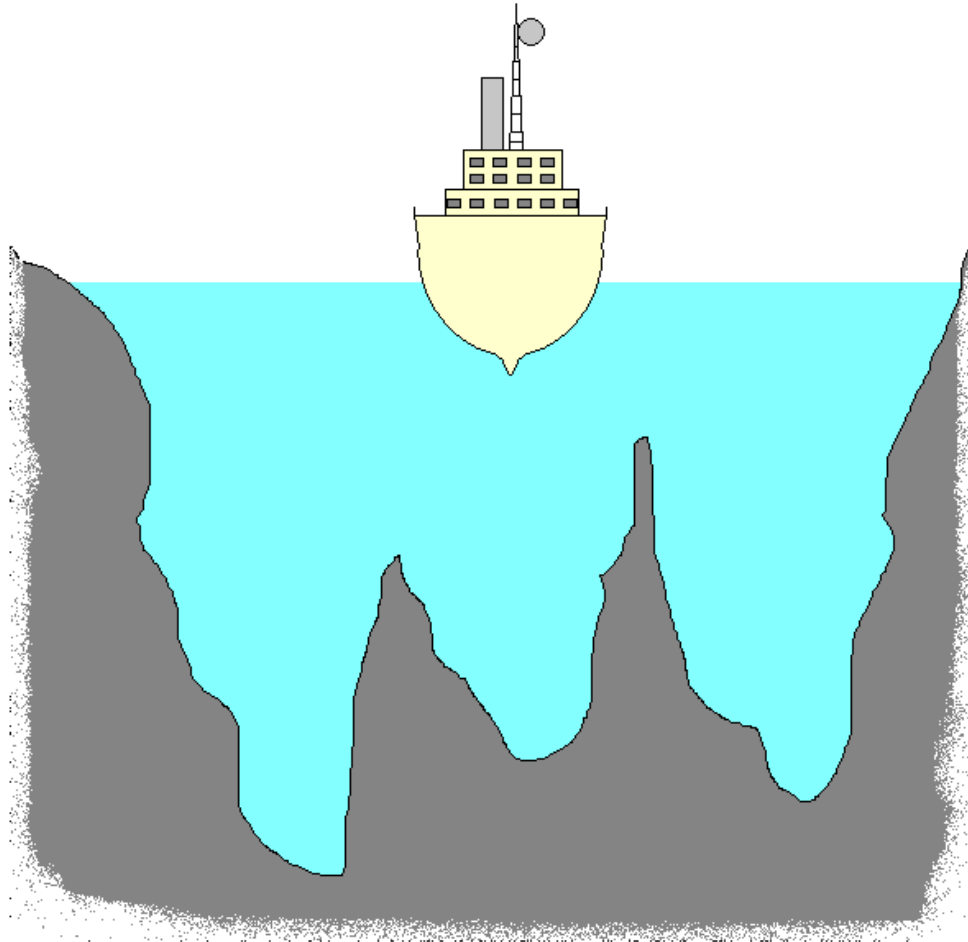
Have you ever been to Greece? Have you ever gone through the Corinth Straits (and the Corinth Canal)? Well, it's a magic shortcut between the Adriatic Sea and the Aegean Sea.

The Canal is, at places, very narrow – it requires pretty good abilities to go through with a large-size passenger ship. That's how it looks:



In traditional (PUSH/MRP/LARGE-LOTS) factories, we don't like hard life. We like to feel comfortable, at ease. We like to sleep quiet. We hate big problems. We get used to daily little problems, that we know how to overcome.

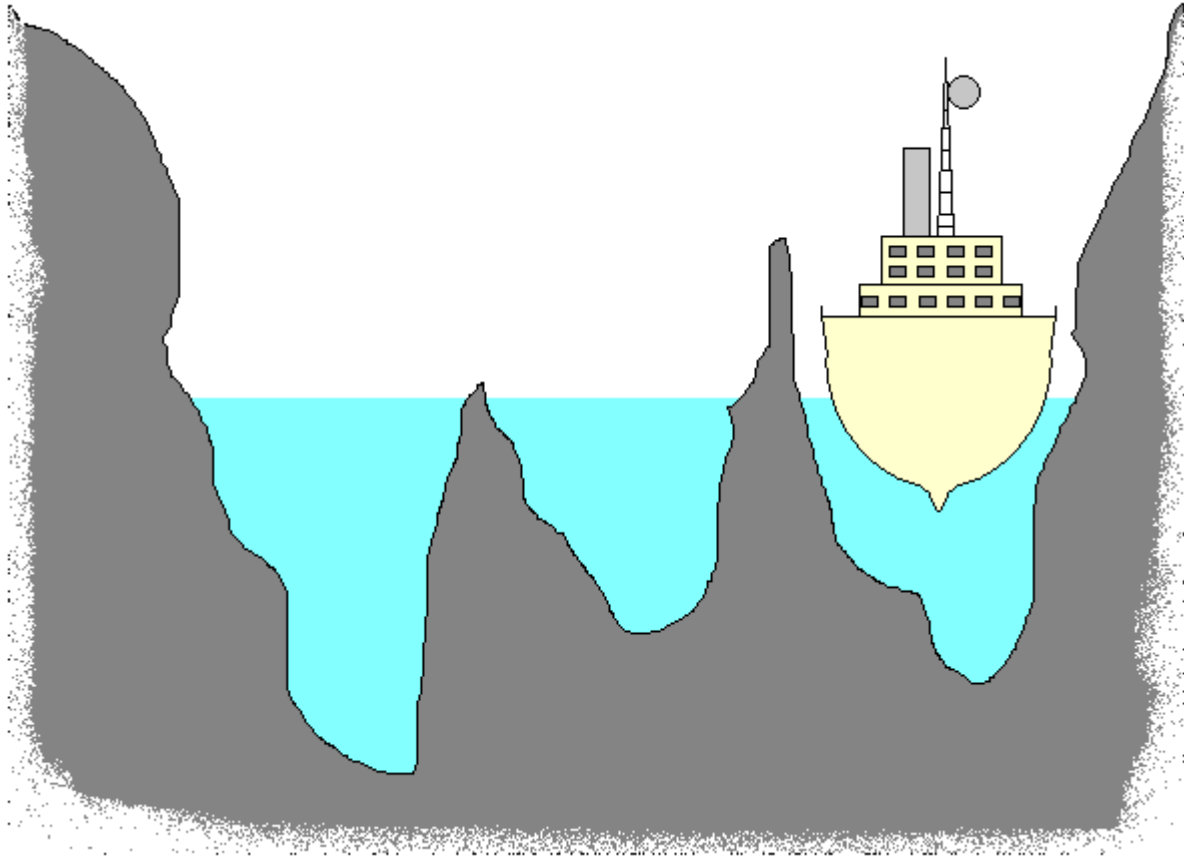
In traditional factories, we don't like navigating through narrow Canals and Straits – it's difficult. We like large Canals, like in the sketch below:



Here it's rather easy to navigate. The man at the steering wheel doesn't need to be a genius – ordinary abilities will suffice.

However, deeper down in the large canal, there are rocks. But, who cares?

Now let's imagine we are able to reduce the level of water in the canal – rocks start getting closer to our ship...



Wow, now that's really hard!
It's like being in the Corinth Canal!

The level of water in the above example is like the level of **stock** and **wip** in a traditional factory. If we lower it, everything becomes pretty awkward, actually extremely difficult to manage! Because now we discover all our **inefficiencies** and all our **waste** (the rocks in the canal)! And we feel the impact! Hard!

Yet, that's the way to become good pilot, good ship drivers, good navigators!

That's also the way to become good, lean people in a lean environment!

We must, gradually, decrease the level of **stock** and **wip** and understand the implications.

That's where the Kanban Method proves to be a good **transition technique** towards **Lean Manufacturing**.

In all these cases, we must definitely produce at a pace well different from market demand: we make wine after harvesting grapes – we produce ice creams to sell in summer (maybe only for two months), starting 6 months ahead (in order to stock up adequately) – and we cope with highly variable demand in the best way we can (overtime – swapping priorities – etc.). Very difficult to go *PULL* (and much more difficult to go *LEAN*) in cases like the above (although we can still deploy a number of lean initiatives to kill *waste* and *inefficiencies*).

the compromise

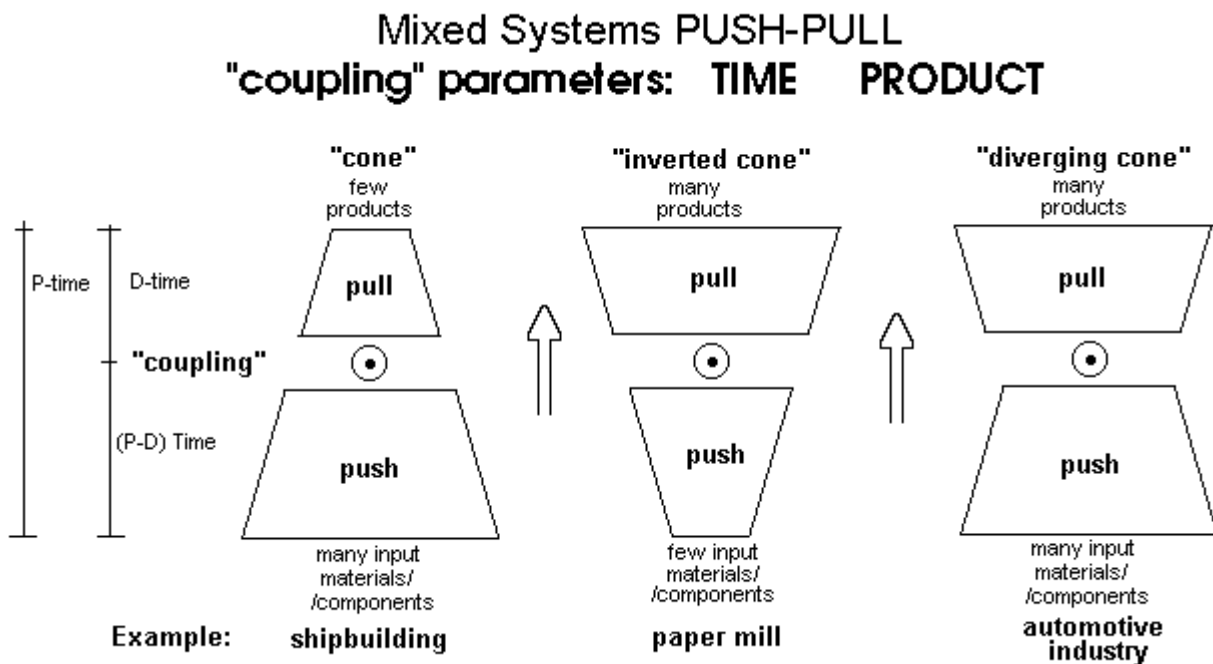
Whenever we have constraints like the above, generally we “compromise”. As said above, not always we can get to **real** (or close to) **LEAN STATUS** – utopia is utopia. What is important – however - is to get better and better, leaner and leaner.

In many instances we need to compromise. We often need to associate a **FLOW/PULL system** with a **BATCH/PUSH system**.

Why?

Because of those constraints illustrated above: simple as that.

Examples of compromises are below:



XXXXXXXXXXXXX - END OF PREVIEW

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MY PHILOSOPHY, MY VISION, MY MISSION

I believe in Value and Lean.

I believe that in many decades of industrialisation we have somehow lost a key word and a key concept: value - value that Enterprises offer to Clients - value generated by productive processes - value produced by managers and employees in their daily confrontation with reality - value produced by plant, equipment, machines, and technology - value brought in by suppliers - value inherent in people know-how - value generated by continuous improvement.....

Today, World Class Performers are re-discovering the vital importance of this key concept, and build enterprises engineered to produce pure, abundant value. World Class Performers are Enterprises that build their competitiveness on the value parameter: their processes are waste-less, and under continuous improvement - their people understand value, and are extremely critical about the way they produce it - their plant and their technology are managed to generate extremely high levels of output value - customers' satisfaction is their primary target, and they achieve it by offering customers an ever increasing level of value - suppliers and sub-suppliers, clients and clients of clients become integral part of a "value-chain" ending only at end-user level - their vision, their mission, their strategies, their targets, their industrial culture, their corporate communication, their organisational structure..... are all focusing on this very, primary concept: value.

I believe that, in a rapidly changing world, featuring globalisation and vanishing borders, all Enterprises, of any size, must and can, today, perform as the "top of the class" by adopting the Value Adding Management discipline as their guiding light.

My philosophy rotates around the key concept of value, and my training and consulting services are structured to enable Small and Medium size Enterprises to achieve higher levels of performance by re-discovering "value" as key parameter for competitiveness and success.

I believe in Integration.

I believe that as specialisation has been the key feature of this century's industry, integration is going to be the key feature of years 2000's industry.

Industry has been built around the concept of "specialisation" from well over a century: processes, products, services, jobs, machine functions, etc. show, even today, a high degree of specialisation. Associated to specialisation, however, there is another feature, which is "fragmentation": fragmentation of processes, of work, of operations, of activities, of tasks.....

I believe that specialisation and fragmentation are enemies number one when aiming at high levels of performance. I believe that only integration sets the path to excellence and real industrial performance.

Integration is associated with flexibility, adaptability, government and control of change: all important features in our industrial world of today and tomorrow. Integration is associated with overall view, overall control, and overall, holistic approach to performance: for too long many Enterprises, especially of small and medium size, have tried to achieve competitiveness and performance by embracing the "fashion" management discipline of the time, be it Quality Assurance, Total Quality Management, Zero Defects, Productivity Improvement, Process Improvement and Management.... or effective Management techniques, or Leadership techniques, or a Continuous Improvement approach, or Management by Objectives..... and even One-Minute Management..... trusting they had come across the truth and the recipe to success, to discover eventually, in many cases, that the improvement in performance was not real, or consistent, or stable.....

I believe that real improvement in performance can only be obtained with an integrated approach, focusing on the key concept of "value" as guiding light, and powered by the use of a number of appropriate disciplines "in consociation" and simultaneous deployment: like to say that targeting at quality improvement without considering simultaneously the productivity aspect is not getting to real improvement, and it has never generated real improvement, because quality and productivity are always the two sides of the same medal - and vice-versa - like to say that focusing on process improvement or process re-engineering without considering simultaneously the primary importance of getting employees highly involved and without the simultaneous deployment of adequate technology-performance techniques can only bring very marginal results - like to say that going for a Kaizen style of continuous improvement without knowing priorities and targets that in certain instances only adequate Benchmarking can provide may fail, as it has failed - and so on: there are many more examples of possible failures due to lack of integration or to excessive focus on an individual, specialised technique.....

Only an integrated view (".....see the tree, not the leaves....." or, referring to my New Performing Systems architectural structure, ".....see the temple, not only the pillars....") can produce valid, high level results.

Because when, and only when, people, machines, methods, techniques and disciplines become an harmonic, integrated combination, in symbiosis one another, can an Enterprise aim at superior performance.

This "integration" key feature, besides, should not only be the task of top management of an Enterprise, but should, to my opinion, be a feature of the Enterprise as a whole, as it may be noticed in World Class Performers: I believe that all minds in an high performing Enterprise must be made aware of the strategic importance of "integration" and addressed to that very direction. I believe that processes must be integrated, work must be integrated (and not fragmented), and approaches must be integrated. Because only this way people may achieve real job satisfaction.

I believe in Simplicity.

I believe that being in business, performing well as an Enterprise, manufacturing products or providing services, is and should be simple, and, most of all, be kept simple, especially in a world in which a predominant feature is complexity. It is my view that if any process, situation, or problem is too complex to be understood, solved or managed, there is something very wrong behind it, and, rather than tackling complexity, complexity should be eliminated to begin with.

As I notice that, in many decades of industrialisation, things have gone more and more complex (I refer to: complex, fragmented processes - pyramidal, bureaucratic, complex, split-function organisational structures - processes built on waste rather than around value - complex management practices - complexity of communication - complex and even distorted thinking, at all levels - etc.), I believe that time has come to bring things back to basics, back to elementary shapes, back to reality, back to simplicity, back to value.

I believe that World Class Performers have well understood this basic concept, and I believe that Enterprises aiming at excellence or superior status must, first of all, re-simplify and make very practical their dynamics, their processes, and their approaches.

I often follow the trend and offer, to participants to my courses, the latest techniques in: communication - leadership - team building - self-improvement - etc.

However I believe that practicality and simplicity are even more essential than techniques. I believe that what counts is the ability to simplify processes and to make them more linear, more human, more understandable. I believe that what is important is to assure value generation at every step of any process. I believe that is extremely important to give people well defined responsibilities, rather than trying to inject, with superior leadership and excellent communication abilities, doses of motivation that cannot get anywhere, just because the very task or the very activity is de-motivating and frustrating in itself.

I believe that accountability for the output of a well defined process gives more job satisfaction and more motivation than a salary increase or a performance bonus. I believe that people must return down to earth to simple, basic concepts of daily value generation through hard effort and acceptance of challenges. I believe that brain laziness is a public enemy to be fought very fiercely. And I believe that people must be responsible for providing their own motivation, their own security, their own quality of life.

I believe in Creativity.

I believe that Creativity (and not Products, Services, Finance, Technology, Management abilities.....) is and is going to be the only and real factor of competitiveness in the next millennium. As Creativity is the common denominator of all other factors of competitiveness. I believe that Creativity is essential for the Enterprise aiming at high levels of performance: Creativity is very important in problem solving, in decision-making, in planning, in team-work, in searching and generating opportunities, in continuous improvement practices..... Creativity is the ultimate secret for achieving high levels of Quality, Productivity and Customers' Satisfaction. Creativity is the spark that makes the difference between Enterprise's excellence or mediocrity.

I believe in the very high power of Creativity, channelled to the generation of value by integration-capable minds, and I stress its vital importance in all my consulting and training activities.

I believe in People.

And I believe that people is the most important resource of any Enterprise, as people may make the difference between its failure or its success.

I believe that people can improve considerably themselves, their performance and the performance of their Enterprise, and that a chance to generate such improvements must be given to people. I believe that it is Top Management primary responsibility to create an environment in which people are given the possibility of performing at high levels. And I believe that this can be obtained by critically (re)designing processes in which people work, and in which people are empowered to generate high levels of value through their efforts, their creativity, their commitment, and their thorough understanding of the process/es to which they are assigned and for which they have high levels of responsibility and accountability. I also believe that responsibility and accountability for a process are a major pre-requisite for people to obtain high levels of job satisfaction.

I believe that people work must be integrated and not fragmented, and that specialisation must gradually make space to multi-skill and multi-function situations.

And I believe that only this way people may re-gain that professional dignity somehow lost in many decades of specialisation and fragmentation.

I believe that work must be a very pleasant experience for all employees, a gymnasium in which people can practise, test and prove themselves, set challenges, improve, excel and be highly satisfied. And I believe that this is easily achievable.

It is my commitment to stress these vital issues in my consulting and training activities, and to convey these priority messages to people in Industry, at all levels.

The above is my vision and my operational philosophy.

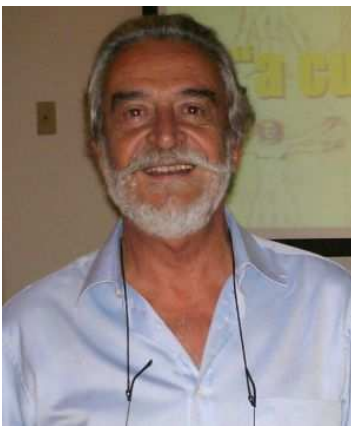
It is my mission, and my thorough commitment, to convey its basic principles to Enterprises and people in Enterprises, with the aim of achieving higher and higher levels of performance.

It is my commitment to do my very best, with honesty and professionalism, to enable Enterprises of small and medium sizes (and as such within my reach and within my own personal capacity and abilities) to understand and make operational the best, up-to-date practices that lead to World Class performance.

Finally, it is my pleasure to commit myself to continuous learning, continuous self-improvement, and, wherever necessary, to continuous change, with humility, and with consciousness of my limited knowledge, always insufficient and always perfectible. Along these lines, it is also my commitment and personal pleasure to get in deep contact with industrial realities of many Countries, and with diversified cultures, to continuous personal and professional enrichment, and to the benefit of my Clients, of the Participants to my training courses, and of all the individuals I will have the opportunity and the joy to get in touch with in the course of my life.

Carlo Scodanibbio

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Carlo Scodanibbio, born in Macerata (Italy) in 1944, holds an Italian doctor degree in Electrical Engineering (Politecnico di Milano - 1970).

He has over 39 years of experience in Plant Engineering, Project Engineering and Project Management, as well as Industrial Engineering and Operations Management.

Free-lance Consultant since 1979, he has worked in a wide spectrum of companies and industries in many countries (Southern Africa - Italy - Cape Verde - Romania - Malta - Cyprus - Lebanon - Mauritius - Malaysia - Kenya - India - Saudi Arabia), and operates as an Independent Professional Consultant and Human Resources Trainer to industry.

His area of intervention is: World Class Performance for Small and Medium Enterprises in the Project, Manufacturing, and Service sectors.

His favourite area of action is: the "lean" area.

He has co-operated, inter-alia, with the Cyprus Chamber of Commerce, the Cyprus Productivity Centre, the Malta Federation of Industry, the Mauritius Employers' Federation, the Romanian Paper Industry Association, the United Nations Industrial Development Organisation and the University of Cape Town.

His courses and seminars, conducted in English, Italian and French, have been attended by well over 14.000 Entrepreneurs, Managers, Supervisors and Workers. They feature a very high level of interaction, and are rich in simulations, exercising and real case studies. The approach is invariably "hands-on" and addressed to immediate, practical application.

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Towards Lean Manufacturing: the Kanban Method

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