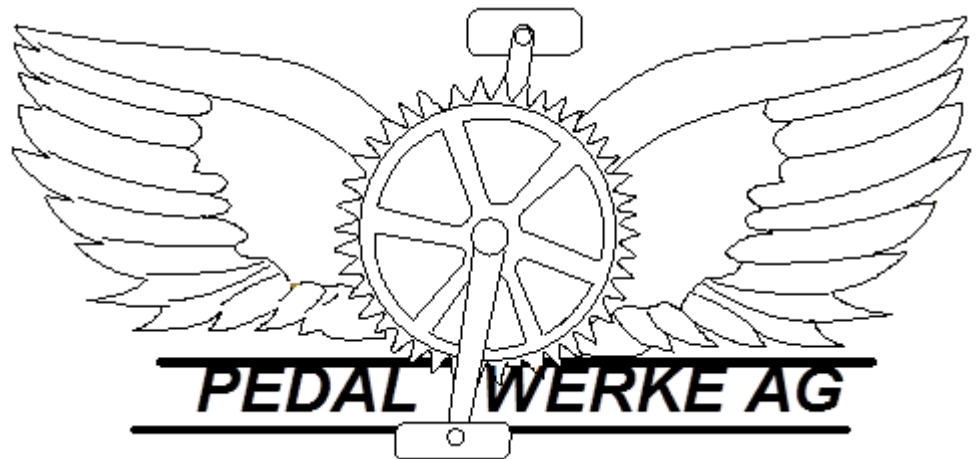


---

# Doing Things Right

Case Study referring to Chapter 6 of  
“Integral Logistics Management – Operations and Supply Chain  
Management Within and Across Companies”, 5<sup>th</sup> ed.



Name, prename: \_\_\_\_\_

Name, prename: \_\_\_\_\_

Name, prename: \_\_\_\_\_

Name, prename: \_\_\_\_\_

Please send to: → [Paul.Schoensleben@ethz.ch](mailto:Paul.Schoensleben@ethz.ch)

---

## 1. Introduction

### 1.1 Objectives

Working on this case study will give you the opportunity to put the knowledge you have gained about flow-oriented processes into practice.

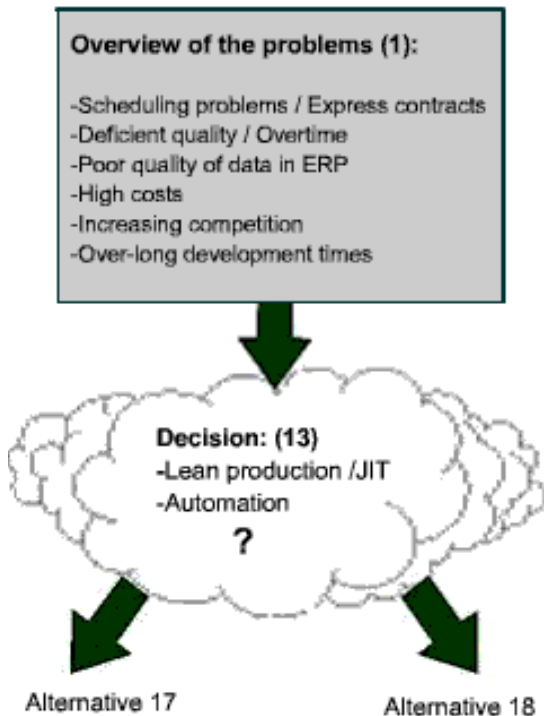
The concepts introduced in the case study are more than just processes operations and supply chain management. These concepts have caused far-reaching changes in production science, changes that require a rethinking, not only in production but in the entire company – from purchasing to sales and from the executive level to the employees in the factory. Today, these changes are known as “lean production”, or “Just-in-time production”. Thus, the case study has the following intended learning outcomes:

- Introduce the philosophy of lean production
- Convey a sense of the philosophy in practical application
- Pass on the educational content in a comfortable form

Prerequisites for this case study are chapter 6 of the book *Integral Logistics Management*, or the corresponding Course 6 under <https://www.opess.ethz.ch/>.

## 1.2 Principle steps and submission of the case study

Read the texts beginning on page 4 (fun is also allowed). Take note of the order in which you read the individual paragraphs. Present your prioritized solutions in the form of a flow chart (max. 2 pages, see example below). State which arguments were most critical for you in making your decision.



In addition, complete the supplementary exercises to the case study as they are mentioned in the text. The assigned tasks indicate what is to be handed in. Here are some additional comments:

**General solution path and production segmentation (supplementary exercise 1):** Try to convince the management to adopt your solution path and the arguments that favor or disadvantage specific solutions. Also, give an overview on basic considerations for production segmentation at Pedal Works AG.

**Setup times and Kanban (supplementary exercises 2 and 3):** The relation between setup times, lot sizes and lead times has a great significance for the concept of lean production. Give a brief summary of the relevant aspects.

Please use the designated space for each task. We expect a professionally worked out solution report as a basis for the top managements decision-making. We further expect a clear reasoning in complete sentences, i.e. not just with keywords, and not handwritten. This also applies to additional pages.

## 2. The Story



### Prologue

This case study gives you the opportunity to put yourself in the position of the Assistant Production Manager at Pedal Works Ltd. Starting on the first day in his new job, you will accompany him through his tasks to his ultimate goal of returning production to a state of productivity.

You will receive all the necessary information. From time to time, there will be a concrete task to solve, measures to formulate or a few questions to answer. Sometimes, you will also be required to make fundamental decisions about what the next step should be, which then brings its own consequences. Depending on which path you choose, you will be referred to a particular paragraph to read (marked with: → x). In this way, you become the decision maker for the process of the case study and you shape the outcome of the production situation at Pedal Works Ltd. However, only one path leads to the intended outcome, although this can also have short digressions connected to it.

Your task is to identify with the Assistant Production Manager, similar to a doing a role-play. Based the knowledge gained from Chapter 6 of "Integral Logistics Management", the instructions in the case study text and the information placed at your disposal first try to find out what the correct path is and then learn what the problems are through the various digressions. Just as is often the case in real life, the information available to you will be incomplete. Complete the scenarios with the missing information by using your imagination and your understanding of people, then establish plausible assumptions that you can defend.

### 1

It's Monday morning. You have just arrived at your new job. Starting today at 8:00 am, you are the Assistant Production Manager of Pedal Works Ltd. When you accepted this position, they promised that you would be the successor to the current Production Manager, who will retire in a year, and become a member of the executive team of Pedal Works Ltd. if you could increase productivity in production.

You know that this will not be easy because during the employment interview, you took a good look at the production department and noticed that it looked chaotic. Materials were lying everywhere, boxes with EXPRESS labels were standing in stacks, and parts were lying on pallets next to the machines. You also know that many machines are often at a standstill because they need to be changed-over to another set-up. In addition, a considerable number of employees are working overtime so that products with defects can be improved enough to reach the desired quality standards.

From conversations with the employees from the marketing department, you have learned that the bicycles are not selling as well as they used to. The products are still of excellent quality, but in the meantime, many other competitors have also reached this quality level, and can produce the bicycles cheaper, which means they can be sold at a lower price. The Production Manager thinks that the competition has much lower personnel costs.

Production is often late delivering the goods. When customers complain, that triggers express contracts for production. In addition, the sales department complains that the competition has already launched new products on the market while the new product lines of Pedal Works Ltd. are still sitting in the design department.

Pedal Works Ltd. has a ERP software package that they use to administer the warehouse and to do the long-term planning, as well as the factory administration/management. Unfortunately, the planning times in the ERP are not coordinated overall with the actual times. Therefore, new short-term arrangements often have to be organized. In addition, jobs are often passed even though all the required materials are not available. The production department is organized as a workshop.

→ 13

## 2

You want to change the layout. Your production units have such irregular use patterns that you are constantly alternating between overtime and short-time. Your layout decision proves to be wrong. If you continue in this way, you will certainly not keep this job for very long! But, you have a stroke of luck and get a second chance.

→ 25

## 3

The next morning at 7.30, you have an appointment with your boss. You step into his office. He looks at you with great expectation and says: "Have a seat!" You start to talk about lean production and JIT principles. Very soon, you notice the your boss's face is tightening up. After a few minutes, he is visibly nervous and finally, he interrupts you: "Listen here, that will never work in this factory! I know about this philosophy too. We had already thought about it during the introduction here at Pedal Works. But, unfortunately, it didn't work at all! The whole Kanban/JIT tool set is only applicable to the automobile industry and for large factories. We are a traditional, quality-conscious Swiss company and our many variations and our limited production numbers should make it clear that this is not for us! Wouldn't it be better to replace some employees with production machines and reduce the cost of salaries?"

You had not taken the problem of the limited number of pieces into consideration and think that maybe your boss is right in his objections. You support his opinion that automation of the production line would be a better solution. He calms down.

→ 17

You think that maybe your boss doesn't have enough trust in the philosophy of lean production and the ideas from JIT. Therefore, you ask him to give you a chance and let you start. And, as you go along, if he is not in agreement, he can always object. He looks at you skeptically, but finally gives his permission.

→ 9

## 4

Your project turns into reality, but with a high investment. You have managed to cut the number of employees in assembly in half and in manufacturing by two thirds. Some computer specialists and CNC programmers had to be hired, but everything is working!

However, after a few months, you notice that the production times have only been minimally reduced. The two fully automated processing centers still have the longest waiting line – just as before. In the complete work cycle of a piece, there are also some simple operations. A machine that cost several million francs was purchased to drill simple holes. It takes the same amount of time to drill a hole as a machine that costs 500 francs. In addition, many other jobs have to wait in line until the drilling is complete. In another area, the driver-less transport system simply took over the earlier transport system and hasn't eliminated anything. It needs just as much time as before, but now it is all automated – and for a very large sum of money!

The high rack storage, which is twice as big as the previous storage space, will soon be full. The request to reduce the inventory and therefore the capital investment in it, have not been achieved. The more room you have, the more room you need. The same has happened in operations: generous spaces have led to larger amounts of materials lying around and goods in process. In contrast, small buffer storage spaces and machine rooms require an overview, so the goods that are lying around must be cleared away immediately. The CIM system certainly saves all the data centrally, but the processes are not any better than before.

With regard to quality, not much has changed. Overtime is still required to improve the output of each process. Therefore, this is not yet 100% percent under control.

In the meantime, your boss has retired and you are now the Production Manager. The operation is certainly very modern, but in reality, it has inherited all the problems that existed when you started. Besides that, you have now turned many of the short-term and flexible costs (employees) into long-term overhead expenses (capital investments). This forces you to use your expensive systems to full capacity. In addition, the problems in design, for example, the long development times for new products, have never been addressed. This affects your flexibility and your capacity to react quickly to market changes. Now, the year is ending and a slow turnover collapse is beginning to show.

→ 24

## 5

You attempted to change the layout without taking the quality and bottleneck problems into consideration. The material flow was certainly rearranged, but this produced many new mistakes that hindered a smooth material flow. You have problems because the machines (and therefore also the processing units) are often brought to a standstill because of quality problems. This strategy hasn't brought you any success!

→ 22

## 6

In order to prepare a foundation for the **Project** "Automated CIM Flexibility", you need information about operations:

- Requirements planned for the current year
- Parts lists and work schedules
- Documents on quality and overtime
- Layout of the frame finishing area
- A compilation of the variations of the Speedy and Rocky bikes

Based on this information, you can build a picture of the production operation. Based on the inventory, you make contact with possible system providers and begin to evaluate flexible processing centers and driver-less transport systems.

→ 4

## 7

You think about your boss's comments about the many product variations and the limited stock numbers and you begin to understand. He means that the individual product groups cause large

swings in production and that makes it impossible to use the capacity of the near-to-line production in any regular pattern.

The fluctuations of the requirements of the end product are closely related to the swings in customer option choices. You see that the variations are differentiated by the following parameters:

Product groups and variations (mountain bikes and racing bikes)

Mountain bike: Rocky

Parameter	Molded form		
Frame type	Men	Women	
Frame material	Aluminum	Steel	
Color	Six colors		
Equipment	Normal	Luxury	Super Luxury

Racing bike: Speedy

Parameter	Molded form		
Frame type	Men	Women	
Frame material	Aluminum	Steel	
Size	Small	Medium	Large
Color	10 colors		
Equipment	Street	Racing	Special

The main component of each product group is the frame, which differs mainly through type and material. The difference between men’s and women’s bicycles is not significant from a technical perspective because, for example, the same prerequisites and operating material can be used. Instead, the big difference actually turns out to be the essential difference between steel and aluminum: steel frames and aluminum ones are welded using different welding technologies and require different machines.

Therefore, you investigate the requirements based only on the main differences: material and type. You find out that the frequency of the swings is very short. When one substitutes months or longer intervals for weeks, a much more regular pattern emerges.

The weekly swings but long-term continuous requirements of Pedal Works for frames of the two main product groups, Rocky and Speedy, gives you the idea that these swings could be intercepted by having a stock room for semi-finished goods at the end of the near-to-line production. A stock room for semi-finished goods with a limited storage period wouldn’t cause any problems because the turnaround is fast enough.

Now you have created the conditions needed for production segmentation.

→ 19

## 8

In addition, you have decided to get better informed about lean production and the JIT principles. You find there is a huge reservoir of highly recommended literature. There are good Japanese books translated into English (and some with following translations into German) as well as American books.

After a fundamental study of the literature, you now have a concrete idea what’s constitutes lean production and JIT. You go over it and summarize your entire findings. As an aid, you find a small glossary with the most important definitions in the section: Terms. After this recapitulation on lean production and JIT principles, you feel that you are ready to speak to your boss about these philosophies. You think that much can be achieved with these methods and want to make

some suggestions to him about adopting them for the production area of Pedal Works. You set up an appointment with him.

→ 3

## 9

It's about to start! You have hardly any idea of how to introduce JIT, but you have to start somewhere. Intuitively, you come to the idea that the first important step is to share these ideas with all the employees. In many meetings, you inform the employees about JIT-related issues and about the problem of wastefulness in all its forms. You convince the foreman that he should be more conscious of keeping order in the workshop and to try to reduce the volumes of materials sitting around, for example, by using a coordinated material flow with defined palette positions. In contrast, the employees are rather skeptical about your ideas in the beginning, but through your openness and your inclusion of employees from all levels, you finally have some success.

Parallel to this, you use the following documents to get better informed:

- Requirements for the current year
- Parts lists and work plans
- Information on quality and overtime
- Layout of the frame finishing area
- Survey of the variations between the Speedy and Rocky models

In order to simplify the task, you concentrate first on the area of frame production. Most of the documents available apply directly to this central area of bicycle production. You can now tackle the next step in your chosen task.

→ 12

## 10

You are planning to reduce set-up times in production. First, you take a closer look at the operation, observe the set-up process and talk to the employees involved. You take the SMED rule of S. Shingo as your First Commandment. SMED means the Single Minute Exchange of Dies. The core of this rule is that each set-up time, even if it's currently 12 hours, can be reduced to a time less than 10 minutes. Therefore, you analyze all the individual set-up procedures and think about what you can do to reduce the time and what you will achieve by doing that.

**At this point, do exercises 2a to 2c.**

Using what you learned in exercise 2, turn your suggestion into reality. Through your ideas and your efforts, you manage to make significant reductions in the set-up times. But, this was no simple task. You found that the biggest problem was convincing the employees that a reduction in set-up time really could be achieved. The "We have always done it this way, it doesn't work any other way! Why should we do it any differently?" mentality was apparently very strong at Pedal Works Ltd.

→ 28

## 11

However, you believe that Pedal Works, because of its product variations produced in small numbers, would gain benefit that is more significant by changing the layout and introducing production segmentation.

You think that new ERP software and a new workshop management system are necessary to finally put the workshop in order, avoid the many “fire drill” situations and meet customer delivery times. To accomplish this, you must still tackle the long-term planning so that your list of requirements will be correct from the beginning.

→ 15

## 12

Now that you know more about the operation and the products, you must actually do something. It is possible that a new layout would bring substantial improvements and a reduction in the transport routes would go along with that. Waste (see Terms) could also be reduced. On the other hand, many quality problems must be solved first in order to achieve a smooth process. You are reminded of your boss’s objections to the many versions and the limited parts supply. You conduct a detailed investigation of the two main product groups, Rocky (mountain bikes) and Speedy (racing bikes), with particular emphasis on the product structures and requirements. It turns out that the variety of products produced by Pedal Works with its corresponding needs for the individual articles does relate very strongly to the weekly distribution swings. Maybe for the time being, it would be better to keep the existing layout and introduce a new layout only when a new ERP software and the workshop administration/management is in place and has been thoroughly tested.

You decide for a fundamental layout change.

→ 5

You think that an improvement in quality has priority.

→ 18

You believe that the largest improvement potential lies in an optimal organization of the IT support for production planning and administration.

→ 11

## 13

You have gone over all that you already know about Pedal Works Ltd rather thoroughly, and have mentally come up with a few solutions. Having noticed that many of the machines are old, you think about a new, fully automated production line with robots. A few universal processing centers and handling robots would smooth out the entire production process and perform more precise operations. The money for these investments is still available in the coffers from previous years. You have also heard that this can be accomplished in a completely different way: the modern “buzzwords” lean production, JIT (Just-in-Time), Kanban and others have reached your ears. It’s possible that behind these “buzzwords” there might be something useful for Pedal Works Ltd. You decide to tackle the reorganization of the frame production first, because you have a feeling the greatest improvement potential is hiding there. Now, you have to make a fundamental decision:

You decide to present your boss with a good concept for the new fully automatic flexible production line. To work!

→ 17

You decide to get more informed about lean production and JIT before making a decision.

→ 8



## 14

The new layout really improved the material flow. Now, production is easier to track than ever before and the number of goods in process has been clearly reduced. The space division, transport routes and process times have also been reduced. It's a good feeling to have achieved something concrete. However, you still have the same lot sizes as before and that means your process times are still relatively high. How can this process time be reduced even more? Should we simply tell the employees in frame production that they should work faster? Surely not! You are once again standing before a decision on how to proceed:

During your literature study, you learned something about the Kanban process. Perhaps this holds the secret of reducing lead times. You decide to introduce this process in the area of frame production as well.

→ 20

On your tours around the factory, you have noticed that certain machines are often standing still. In conversations with the various foremen and shop workers, they confirmed that this is due to changing the set-up. You had actually already noted that fact earlier in your basic process analysis. You decide this problem is next on your list.

→ 10

You establish that in front of each individual work space, large buffer stocks build up because they are produced in large lots. You are convinced that small lot sizes, which can be moved on to the next work station a lot quicker, would sink the both the lead times and the buffer storage. Therefore, you decide to reduce the lot sizes.

→ 27

## 15

You keep to the traditional forms of workshop administration. Think about it though: What will happen if you go on like this? You will partially maintain a technologically oriented workshop, i.e., a system that contains a lot of waste (see Terms). Without researching the causes of this waste or trying to eliminate it, you try to control and optimize the whole process through management expenditures and coordination expenditures (i.e., causing still more waste).

This company has been successful for the last twenty years using this approach. Even today, some companies are still using it successfully, but only until the competition appears in the same market segment and produces the same product perhaps 20%, 30% or 50% cheaper. At the latest, this is when companies notice that it can go another way. Then they find out that the principles of lean production and JIT enable still more improvements and this is independent of the products or products structures because the improvements come in the areas of quality, awareness of waste, design, and customer and supplier relationships and management.

For you, this case study is over. Try again with another strategy, perhaps you can arrive at a better result!

## 16

On one hand, you are happy with the results, but on the other, you see that in comparison to the competition, Pedal Works takes far too much time to develop new products, longer than average. It looks like there is still plenty for you to do. So, as your next project, you want to take a closer look at the development process. This reveals several problem areas: The development phase is basically sequential with many partial steps. It often happens that parts are designed that later cause difficulties in production. Parts similar to those already in stock are ordered which then inflates the storage. Many parts then sit in stock in relatively small numbers for a long time because they are seldom needed.

Your goal in this step is to speed up the development process, reduce the many extra parts and ensure a production-oriented R&D department. The keyword here is: simultaneous engineering. This means that the development process runs simultaneously rather than sequentially. Employees from the areas of sales, purchasing, design, preparation, production and even the suppliers, work in independent teams together on concepts for new products. The entire development time is shortened, because the various jobs are performed beside one another instead of one behind the other. Everyone is a participant in the process and can bring in their knowledge and their needs. This ensures that, for example, the designer can take the problems and requirements of sales, production and purchasing into consideration and use that information in his designs. So he designs fewer new original parts or and makes standardized parts or other parts that are suitable for production. The kind of thinking in islands must be created throughout the whole company! But the various area and department borders will not easily be overcome. However, from your earlier projects, you have now had the experience that it can be done. Therefore, you are understandably confident.

An essential element of simultaneous engineering is drawing the suppliers into the process, in cases where purchased parts are used. The supplier knows his processes best and he knows the least expensive method for producing parts. That's why the supplier's representative needs to be integrated into the new development process of Pedal Works Ltd. It means that price suggestions can already be discussed during the development process. One can also agree on how the price should develop over the life cycle of the product, for example, the unit price could be lowered over time. Using a fixed agreed price also means that all the improvements that the supplier makes in his own production process in order to produce more cheaply for you, accrue to his benefit. Pedal Works will also not suddenly change and put pressure on him about the price. The suppliers then have as big an interest in doing process improvements as in a price increase.

→ 29

## 17

You have decided for an extensive automation of the factory. Admittedly, you still don't have any concrete ideas about how it should look or what it would cost, but you want to talk to your boss at some point about it. You think that a major automation of the factory would save a large part of the expensive personnel costs and you want to convince him of this. You make an appointment with him.

You have an appointment with your boss the next morning at 7.30. You meet in his office. He looks at you skeptically and says, "Take a seat." You start talking about automating several work stations and the fantastic possibilities provided by using handling robots. You notice that your boss is reacting positively to your suggestions. He is impressed by your ideas and advocates an integrated CIM solution. Instead of the current workshop organization, the old machines could be discarded and some fully automatic processing centers could be set up. The assembly stations could be replaced in part by handling robots. Besides that, a driver-less transport system could connect the various stations and a high rack storage area could be built that would double the current capacity.

You are glad that your ideas have pleased your boss so much and you stay an extra half hour to discuss the details of this major process. You come up with the idea to connect everything with a CIM data bank. All company data would be centrally managed and all the work areas connected. Your boss says that he will go to the management team and get the funds authorized for the project. You also find a great name for the new **Project**: "Automation CIM Flexibility".

You are inspired by these ideas and plunge into work.

→ 6

## 18

It is true. The quality problems in operations are very big. As the evaluation on quality and overtime indicated, Pedal Works produces too many rejects and 30% of the parts produced must be reworked in order to achieve the quality standards.

You have read that the first commandment of quality should be "Quality at the first go" or "Zero Mistakes". Just to achieve this is a project in itself and a very difficult one at that! You know you can never manage this alone. You will have to get all of the employees involved in this project. Each must be aware that the following position is relying on receiving perfect parts. Looking at the current process reveals that checks are only done at the very end. You could call it a "post-mortem certificate", only then are defective parts discovered. This means that mistakes cannot be found, traced, shared or discussed in a way that would help prevent future problems. How can quality be improved using such methods?

To reduce the defect rate, you introduce informative control as a first step, which means that the position that produces a reject must be informed immediately when the mistake has been established. At the same time, you place random sample controls at the end of the line, with 100% control procedures during the process. Because, with random sample controls, you will never achieve a zero error rate.

Self-control has many benefits, mainly because it guarantees immediate feedback. On the other hand, with self-controls, the employees can make a mistake or a compromise in that they accept a defective part. One can avoid this however by introducing the improved self-control system. One can set up guidelines that automatically signal mistakes. These give the employees automatic feedback on how to achieve 100% control and help to avoid mistakes. Such solutions are called poka-yokero, which means a fool-proof solution (see Terms). A poka-yokero can signal when a mistake is discovered, and depending on the situation, totally stop the process or signal the employee. The implementation of such guidelines requires a very detailed analysis of the processes and a lot of creativity as well as technical knowledge.

You must also stand the machine maintenance procedure on its head, meaning that you don't look for rejects to repair, rather that you strive for preventing rejects in the first place. You introduce a plan of regularly checking the condition and operation of each of the machines. The employees are also required to report any irregularities as soon as they appear or are noticed.

You realize that this step is lengthy and complex. It will keep you busy for months. But in the end, you manage it. All the employees now know the characteristic quality problems and are in a position to recognize imperfect parts immediately and take care of them. This was a very difficult step on the road to success. Your boss is impressed with your performance and places more trust in you.

→ 25

## 19

Now you want to take on production segmentation – that means moving from a technologically oriented layout to a production-oriented layout: a specific production unit will be available for each product or product family. In order to estimate the savings potential of having such production units (near-to-line production) and gather arguments to convince your boss, you conduct a very important analysis with a so-called basic process analysis or "a walk-around process analysis". You accompany a part throughout the entire operation and note everything that happens to it. You divide all the phases that the part goes through into five categories: operations, transport, control, general waiting periods and lot size-dependent waiting periods. You also summarize the various time periods and route lengths. **(At this point, do exercise 1a)**

The results of this analysis are astounding. You see that this process is a fraction of the total time – but it is exactly this process that effectively raises the cost of this part. In addition, the part is transported nearly a kilometer - through the entire length of the factory!

All of this is waste, it costs money and doesn't bring in one red cent! You show your boss the results. He is impressed. He says that he agrees with your idea, and proposes using the two product groups as an implementation test. You retire to your office to think about which criteria should be considered for building this near-to-line production unit. **(At this point, do exercise 1b)**. Based on your reflections, you decide to build an island for steel frames and one for aluminum frames.

It's done: the machines are finally all moved into place! The near-to-line production units for the frames of the two main products groups have been built. For products with sporadic demand, the reduced production workshop system is still being used. And naturally, not everything can be moved around: The painting unit stays where it is because of its special set-up and equipment (ventilation, catch basins). You try to quantify the benefits accruing from the new layout. **(At this point, do exercise 1c and 1d)**. With the figures you have now prepared, you can present your boss with something concrete.

You have made an important step in the direction of improving the productivity of Pedal Works, but it is still too early to celebrate. There is a lot of work in front of you. But, you can stop for a minute and enjoy a short pause, maybe drink something. But then, it's back to work. Go on to → 14

## 20

You have decided to introduce the Kanban process. Doing this involves several steps.

You have tried to introduce the Kanban cards without having created the required conditions, in particular, you have forgotten about the lot sizes and the related set-up time reduction. (Why? Because you were half asleep during the lecture on Operations and Supply Chain Management.) Because of the mess you have created, you give your notice and apply for a new position selling vacuum cleaners for Hoover! You think you can develop your capabilities better in door-to-door sales. This case study is over for you – unless you try again with another strategy!

## 21

Unfortunately, success does not come to you. Instead, after a short time, complaints about the still high lead times, poor performance in meeting deadlines and the limited capacity start coming in. Naturally, you feel compelled to do something about these negative developments. First, you must find out why things went so badly. You notice that your newly organized production cells are doing nothing half the time – and even more often than before your efforts to reduce lot sizes. You have huge capacity problems, the employees often have nothing to do, and stand around for hours while the machines are being set-up. Then, you have a flash of inspiration and you finally understand: the lead time can only be reduced if the set-up times are reduced first.

→ 10

## 22

After you have set the wrong priorities, the employees rightly think that at the ETH one only learns theories and nothing about the hard reality of everyday business. Your boss sees your mishap and suggests that perhaps you had better dedicate yourself to the workshop management project with the ERP software suggested earlier.

You agree with your boss.

→ 11

You go to your boss on bended knee and beg for another chance to do this step again.

→ 12

## 23

Naturally, you are pleased about all that you have already achieved. You have managed a solid improvement in production with the measures you have implemented to date. You have also reduced lead time enormously. This shortened the delivery times and at the same time improved meeting the deadlines of your customers. You think that perhaps now your workday will be a little more peaceful.

"Unfortunately", it is not yet time to rest on your laurels. There is still more to be done. The person responsible for the incoming stock will turn up soon with a problem. The stock of goods in process and those in the semi-finished and finished products storage have been massively reduced, but the storage for incoming stock is just as large as before. This stock room requires a lot of space and ties up a lot of capital. One reason for this is that your firm buys many diverse articles and parts, keeps large reserves, and has contact with a large number of suppliers for special parts that are needed depending on the situation and the momentary conditions. On the other hand, the high level of supplies is also because though the production area is predominantly oriented towards demand and products, there is still a need for storage for incoming goods because the suppliers operate on weekly or monthly delivery schedules, which do not coincide with the schedule of the production units. You are getting the picture that incoming stocks storage are bringing a lot of waste with them. Therefore, you start thinking what could be done about it.

→ 26

## 24

The moment has arrived: You have to present last year's results to the management team. They have invested a lot, but the improvements are still lacking. The members of the management team are not happy with your performance. After a short retreat with the other members, the president addresses you and says that it has been wonderful working with you, but unfortunately, everything must come to an end one day and for you, this is it. You're fired!

For you, this case study ends here. Try again with a different strategy.

## 25

The question now is how to continue. You haven't forgotten that your goal is to eliminate waste. In order to reach this goal, you must re-arrange the layout to support the flow of materials. On the other hand, you are worried about the fluctuating requirements for materials. Is it possible at all to attempt production segmentation with such demand numbers?

You think that something has to be changed in production.

→ 2

The first thing you want to know is how much the demand numbers vary and if this varied demand would even allow a regular loading of the production system.

→ 1

## 26

You collect documentation about the various suppliers and about each individually related sales part ordered from them. In a conversation with the head of the purchasing dept., you try to understand the reason for the large number of suppliers. What comes out is that the reasons are manifold: many varieties of similar parts, custom-made parts, the desire to obtain a certain independence from the suppliers, etc. This results in an inordinate amount of time being spent nursing the contacts with various suppliers, doing the quality testing needed for each offer on a new requirement, deciding how much to order for a good price, playing the various suppliers against each other in some circumstances, and testing the quality of incoming goods.

You try to work out whether it would be sensible or possible to reduce the suppliers to a reasonable number, with whom one would be able to cooperate more closely, for instance, with regard to delivery terms, quality, development of new parts, etc. A purchasing department that is over-large and doing unnecessary work is also a form of waste. And in the long run, it doesn't make sense to play the suppliers against one another to push down the price because the danger is that the supplier will try from his side to push the price up again as soon as the customer is dependent on him. A close and positive cooperative relationship with some of the trusted suppliers seems much more sensible to you. A close cooperation would be something concrete; for instance, during with the negotiation of contracts, it would mean that each side would know about the processes of its partners and they would agree to a fair sharing of the profits. A win-win attitude is desirable, compared to the current method of trying to exploit the weaknesses of the "opponent".

With this goal in mind, you throw yourself into your work! The first step is to build a group of suppliers. These could be based on the categories of an ABC analysis, which classifies purchased parts based on their amount and value content. Next, you have to work out criteria that are crucial for choosing the preferred suppliers within the individual groups.

You find three areas in which an improvement would bring great benefits to Pedal Works:

- Number of suppliers ⇒ closer cooperation with fewer
- Quality control at point of delivery ⇒ eliminate when possible
- Delivery times, delivery quantity ⇒ demand-oriented delivery

It naturally follows that the supplier should not be selected based on a temporary special offer, but rather based on the conviction that it is possible to enter into a long-standing cooperation with him in a mutually beneficial committed business relationship. Part of this means that Pedal Works should look at the operations of potential suppliers in order to be able to judge what kind of development potential they hold for the future. In this context, the importance of guaranteed quality also shows. In the same way that you expect high quality in production, you expect high quality at the point of delivery. The eventual goal would be to eliminate quality controls upon delivery. Based on the close cooperation and increasing trust you will be able to invest in your suppliers, it would also be possible to reduce the high reserves because overall there would be fewer uncertainties. In order to reach a suitable delivery schedule, suppliers would be taken from the geographic vicinity with whom an outline contract for the required amount per period can be agreed. Based on the outline contract, Pedal Works could then call up at regular intervals for supplies needed for JIT. The Kanban process could also eventually be extended into in this area.

In Germany, and increasingly in Switzerland, there has been a storm of protests raised in connection with the transport problems related to JIT. The criticism is that with JIT supply system, storage space is being moved onto the street in trucks and goods are being driven all over Europe in order to deliver JIT. Or, for instance, that between two factories within fifty kilometers of each other, a truck simply drives up and down every hour in order to meet the rotating delivery deadlines. The Just-in-Time system in such cases would only lead to "Just-in-a-Jam" and bring the traffic system to a collapse.

This argument, as you already know, has nothing to do with the actual JIT philosophy, and is probably based on a misunderstanding and highlights only the temporal aspects. Therefore, the concept of lean production is better because it is clearer. It emphasizes the goal to radically reduce every possible waste, if possible in every area. This is also the central aim of JIT,

including waste along the interface between suppliers and buyers. As transport is at the top of the list of wasted money, one reasonable view could be that suppliers as an extension of one's own production and operations. Then you have the consequence of striving for the shortest possible routes for external transport in the same way that you implemented short routes in your own factory by using production segmentation. It would mean that local suppliers are preferred.

In cooperation with the employees from the various areas (purchasing, production, design, etc.) the needs of Pedal Works Ltd in its cooperation with suppliers should be discussed and concretely formulated. On this basis, the purchasing department can evaluate present and potential suppliers, contact selected firms for closer contacts and enter into detailed negotiations. You are convinced that Pedal Works will reach this new goal and that you have taken the right road.

→ 16

## 27

You want to reduce the lot sizes in order to shorten the lead times. That is sensible. You sit with the employees who are responsible for planning the work and capacity schedules. From them, you receive a list with information about the present average lot sizes. The first thing you want to do is consider reducing the lot sizes and you make a list with the corrected values. Based on the information, a new schedule and capacity plan for the next few weeks is drawn up. You are pleased at having introduced something new again and hope to be able to see the results of your efforts soon.

→ 21

## 28

In the area of frame production, everything has settled down. The reduction of the set-up time has enabled you to reduce the lot sizes and therefore the lead times have also been drastically reduced. Frame production is now setting a fine example. You can show your visitors your production hall with pride.

What you have been doing for frame production, you can now implement in all other departments of bicycle production, for instance, sub-assembly and final assembly. What's left is to make the connections to the near-to-line productions, those which are not or cannot directly be part of the production chain, e.g., within frame production, a connection between the near-to-line production and painting, or the connection between frame production and the items made earlier, such as part production (for example, cutting the tubes). Simply put: "Tying things together."

In order to do this, a steering process and regulations are necessary in accordance with the lean production philosophy – with minimal effort and a clear overview. In this connection, Kanban would be a possible steering system. It could serve to control and coordinate the activities in the company. You might want to eventually use this system in the production area of your firm. To be able to explain Kanban to the employees affected by this decision, you have to find out for yourself exactly what this term means. **(At this point, do exercise 3a to 3g)**

By solving exercise 3, you have found out, to your great satisfaction, that all the conditions for introducing Kanban are already fulfilled. Therefore, you decide to go ahead and introduce it. Before you introduce it, you have to decide on the maximum size of the buffer storage at the workstations based on the material requirements and the work schedules, the size and number of the containers and the necessary number of Kanban cards. In the first run, you conclude that not everything runs as you imagined it should. In order to ascertain the ideal sizes of the runs, you do some test runs. In the end, all the participants are satisfied.

→ 23

## 29 Epilogue 1

Congratulations! You really have achieved something! In a relatively short time, you have done something that few employees thought possible until recently. The Production Manager is also convinced by your achievement. He tells you that he intends to suggest you as his successor at the next management team meeting. You are happy about this recognition, of course – and, you have reached the goal you had in mind since your very first day at Pedal Works. You are also aware that a lot of work will be waiting for you and that you will have to continue put your full dedication into this project. Therefore, you decide to take two days of vacation in order to prepare yourself for these future challenges.

You return full of drive and energy from your short holiday and immediately start to get to know your future tasks. You are learning everything about the regular cycles in your future area of responsibility. And you receive your first managerial task. Soon after, your boss retires and you officially take over the as Production Manager for Pedal Works Ltd. So far you made a meteoric climb in your career. Hats off to you!

You notice quickly that there is a lot to be done, just in the daily operations alone. Therefore, you are glad that your previous project was successfully concluded before your vacation and that you do not need to do that on top of everything else. You are quite satisfied with yourself because of the positive achievements in the last project and you want to be able to concentrate completely on the new task at hand. The most urgent problems have been solved by total dedication, but now you can take things a little easier.

→ [Epilog 2](#)

Beside the daily demands, you continue to look for further opportunities for improvement, as you did in your last position. This places an extra burden on you on top of your usual job as Production Manager. You can hardly concentrate for any length of time and have the feeling that somehow you are achieving nothing at all. You do a little of everything and nothing well.

→ [Epilog 3](#)

## Epilogue 2

However, you have not figured your employees into the equation. They have been involved in the whole project and now give you their suggestions for improvement. Lean production has become a part of their own thinking. In this vein, they try to continue to eliminate waste as soon as it turns up, to improve processes and to strive for higher quality in all of the departments. They keep arriving in your office with suggestions for continuing improvements or to point out problem areas. This shows you that, contrary to your own thoughts, this project has not really been completed - and it will probably never be! You realize that in the future, it will continue to be your responsibility to seek improvement possibilities within your firm.

→ [Epilog 3](#)

## Epilogue 3

You are convinced of the necessity of continually searching for improvements, even when you have done a good job, it is not enough to lean back and view the results. There are enough areas that could use some improvement activities. However, you have to admit that your capacities are not sufficient to cover both a staff and a line position. You are wondering if you should employ an assistant who could take over your previous job. At this point, in order to formulate the job description, you go over the details of the areas of responsibility that your new employee should take over.

These responsibilities all correspond to the kaizen philosophy (continuous improvement) – the continual search for improvement opportunities. Where does kaizen start? Actually, you already started it when you were working on the quality problems in production. Now, it is the general striving for continual improvement and the expansion of quality awareness, not only in production but also in your colleagues in the finance department, in sales and purchasing - in



the entire company. It is very important that you and the entire management team see that continual improvement brings more benefits than the occasional innovation. In management meetings, you work on sharing this philosophy with all the people involved and try to make it the philosophy of your company. You are convinced that this is the only way to achieve long-term success and to maintain the ability to compete.

It is nine o'clock in the evening and you are writing the last few sentences for the annual report of Pedal Works Ltd. You are looking at the city lights from the window of your new office. Two years have passed since your first day at Pedal Works. Much has changed during this time. Your colleagues in marketing have also made great achievements, they are up-to-date on the current trends and the needs of their customers and now take these into account. Colleagues in research and development have succeeded in actualizing these needs in their production ideas. Even production is a good example. The customers are impressed by the punctuality of Pedal Works' deliveries. Your bicycles are winning awards and seals of approval from consumer magazines. The bicycle scene is impressed by the price/benefit ratio of the new product line, and the growth rate of incoming contracts has impressed the sales dept. When the Finance Manager was reading the final balance sheet, he came and read them off to you because he could hardly believe the figures: "We are in a recession. It is hardly possible that we are doing so well." Just last week, the meeting of the top fifty suppliers took place and the new contracts were finalized.

On top of that, a journalist from *The Wall Street Journal* called yesterday and wants to write an article on you and Pedal Works. True, you haven't done a bad job, but the market is changing daily. And the competition does not sleep!

The report is finished. You turn off your computer. Another long day of work is over. You leave your office and walk down the dark corridor to the lift. You are looking forward to the exciting journey home with your new vehicle. At this time of night, there is hardly any traffic. You can drive as fast as you like. You go into the parking garage and when the door of the parking garage opens, you glide out soundlessly into the fresh evening air on your brand new bicycle from Pedal Works.



---

## Exercise 1: Production segmentation

- a) You will find the layout of Pedal Works in Annex 1. With the help of the basic process analysis in Annex 2, fill in, directly on the Annex 1, all the routes of all the parts of an aluminum frame on the layout. **Note:** Real routes are going through doors and corridors. Please consider this when calculating the length of the routes in task c).
- b) Which basic aspects should be taken into account while building near-to-line production cells? Why is the construction of islands for steel frames and aluminum frames especially useful?

- c) Compare the old layout from task a) (Annex 1) with the layout of the successful rearrangement in Annex 3.

Now complete the basic process analysis for the aluminum frames based on the new layout (including the corresponding fittings). Your goal is a rough, conservative estimate of the necessary changes. The following step-by-step procedure may help you:

- First consider what results would be obtained purely through changing the layout, what results would remain unchanged with the new layout and which results could not be clearly assigned.
- Estimate the changes and explain any related assumptions.

- Note that lot sizes, resulting waiting times and setup times do not change at this stage.
- Now put the completed values in a new (virgin) business process analysis form (Annex 4)

**Hint:** Transportation times are not respected for the calculation of lead time in the Basic Process Analysis (Annex 2). Therefore, a reduction of transportation times has no impact on the lead time measured. In contrary, omission of stocking levels has a considerable impact on lead times.

- d) Evaluate the improvement potential that the introduction of production segmentation will bring.

**Evaluation before and after production segmentation:**

	Before	After	Savings [%]
Length of transportation routes			
Lead time			
Space occupation			

- e) What are your conclusions?

- f) Which steps will be next in order to improve the situation?

**Annexes (see at the end of this document)**

- Annex 1: Layout (actual state)                      Annex 2: Basic Process Analysis
- Annex 3: Layout after modifications            Annex 4: An empty form sheet

---

## Exercise 2: Set-up Time Reduction

- a) What do you have to do to make a decisive reduction in set-up time and what techniques can you apply to accomplish this?
- b) What effect does reduced set-up times have on lot sizing?
- c) What connection exists between lot size and lead time?

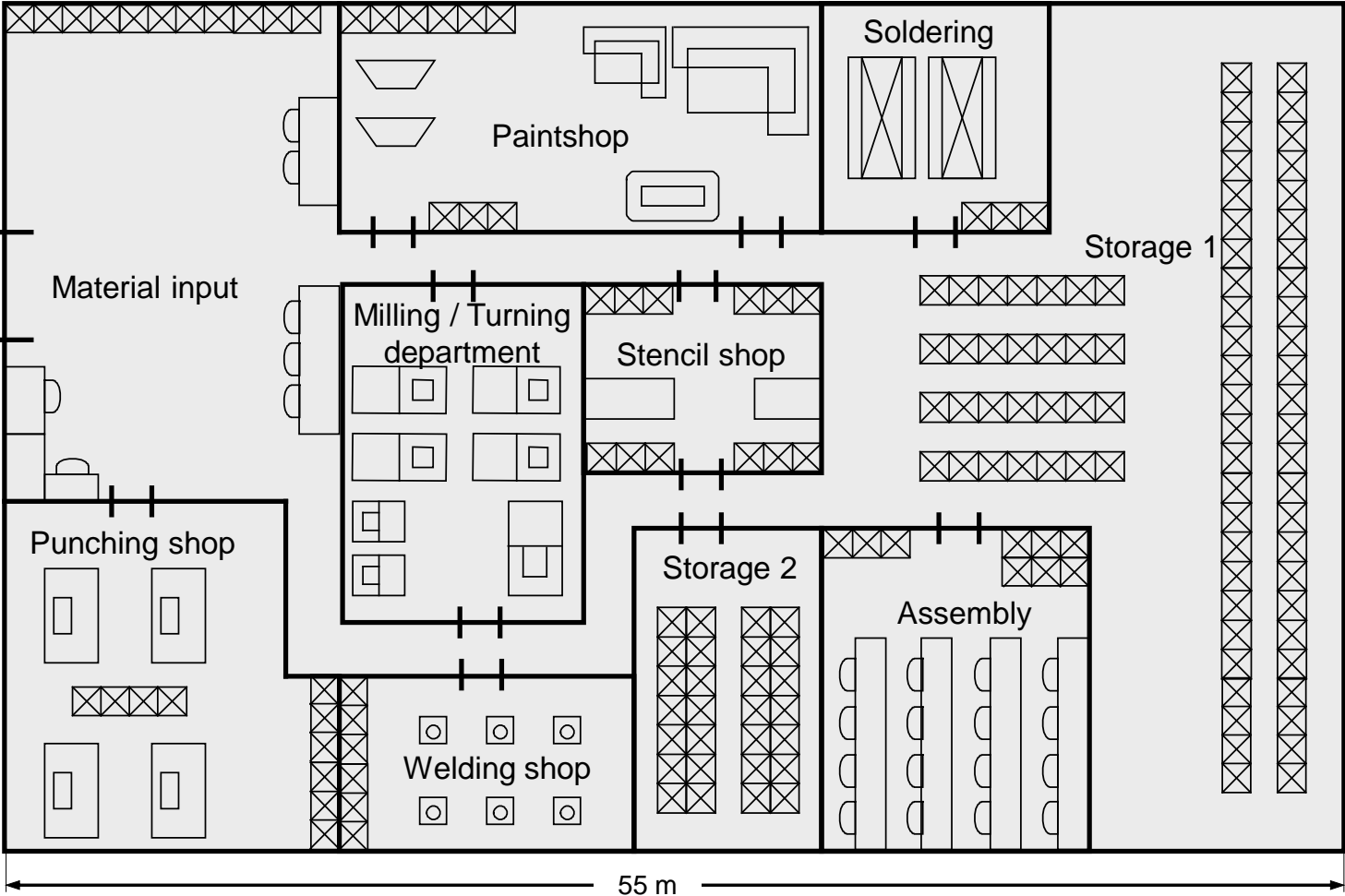
---






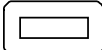





## Exercise 3: Kanban

- a) Please mark the correct statements about Kanban.
1. The Kanban technique can contribute to the reduction of storage.
  2. Kanban is a system for the long-term planning of stock and goods flow.
  3. Kanban is a system for controlling the flow of stock and materials.
  4. Kanban supports the push principle.
  5. A Kanban production or procurement order release does not entail a storage at the (internal or external) customer's site.
  6. Kanban can be introduced at any time because it is such a simple principle; there is no need to fulfil any special prerequisites.
  7. The administrative expenditure for ordering materials will be reduced by Kanban.
  8. To obtain materials, the employee writes the quantity required on a Kanban and sends it off.
  9. Kanban is not limited to the internal flow of materials, it can also be used between companies.
  10. Independently of the safety stock foreseen by the Kanban technique, each work station should keep a small reserve just in case.
  11. The Kanban system only functions in Japan.
  12. The number of Kanban cards will limit the inventory of a buffer storage.
- b) How big should Kanban lot sizes (=number of items per bin) be? Why?
- c) On a walk through the factory, you happened to notice that the foreman waited till one or two days after the reception of a Kanban bin to kick off the corresponding production. Is this of importance for the Kanban system? Explain.
- d) A friend reports that he intends to install Kanban to solve the continuing quality problems in his factory. What advice do you give him?
- e) Why are small lot sizes a prerequisite of the successful application of Kanban for expensive or voluminous items?
- f) What is the function of the cards used in the Kanban system?
- g) Have the necessary conditions for the introduction of Kanban at Pedal Works been fulfilled?
- h) Do you see similarities and fundamental differences between the Kanban technique and the (re-)order-point technique?

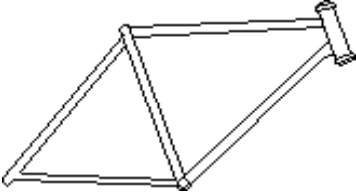
# Annex 1: Layout (actual state)

## Frame-production Pedal Works Ltd. Layout before the reorganization



- |   |   |   |  |   |  |
|---|---|---|--|---|--|
|  Punching machine |  Soldering furnace |  Milling machine   |  Storage          |  Stencil         |  Painting furnace |
|  Lathe            |  Assembly table    |  Welding equipment |  Painting devices |  Washing machine |  |

# Annex 2: Basic Process Analysis (before the reorganization)

Drawing 					
	<b>Name of Part</b>	Fitting and frame Alu	Part-Nr.		
	<b>Inspector</b>	Assistant, Executive producer	Idate of inspection		12 May 200x

Nr. of Parts	Distance	Time	Symbol	Location	Activity	Worker	Machine	Mode of Storage	Comments
60 Fittings		5 Days	O	Storage 1				High rack warehouse	
	60 m	3 h	*	Punching Shop	Deposit	Carrier		On pallets on the floor	Not 100% control, 20% defective parts
		20 s	&	Punching Shop	Punch	Worker	Punching machine	On pallets on the floor	Tool change takes 40 min
		10 min	x	Punching Shop	Deposit				
	35 m	3 h	*	Milling / Turning depart.	Deposit	Carrier		On pallets on the floor	Complete palette
		10 min	&	Milling / Turning depart.	Mill / Turn	Worker	Milling / Turning machine	On pallets on the floor	Parallel processing on two machines
		150 min	x	Milling / Turning depart.	Deposit				
	25 m	16 h	O	Storage 2	Roll in	Carrier		Palette stashed	
		2 min	&	Storage 2	Roll out	Warehouseman			Configuration for 20 frames
		20 min	x	Storage 2	Commission	Warehouseman		On trolley	
20 Frames <sup>*)</sup>	5 m	2 min	*	Stencil shop	Stencil	Carrier			
		20 min	&	Stencil shop	Deposit	Worker		In stencils on the floor	Stencil lock is jammed
	20 m	2 h	O	Welding shop		Carrier		Queue	Parallel processing on 3 capacity places
		10 min	&	Welding shop	Welding	Welder	Welding equipment		Defects in weld seam due to stress because of stencil
		200 min	O	Welding shop	chill			In stencil	
		2 min	%	Welding shop	Sample check	Welder			
	40 m	2 h	*	Paintshop		Carrier		Paletts	
		3 min	&	Paintshop	Wash	Worker		Queue	
		15 s	%	Paintshop	Check of cleanness				
		3 h	O	Paintshop	Dry			Paint frame	Color change 30 min
	3 min	&	Paintshop	Paint	Painter	Painting device			
	30 min	x	Paintshop	Paint	Painter				
	6 h	O	Paintshop	Hardening		Painting furnace	Paint frame	Hardening and cooling off	
35 m	3 h	*	Assembly		Carrier		Paletts		
	10 min	&	Assembly	Montage	Worker	Montage	Queue	Montage of frame attached part	

X: Lot size caused waiting time \*): Transport

Each frame requires three fittings in order to connect the pipes belonging to each frame

&: Process

O: Waiting time

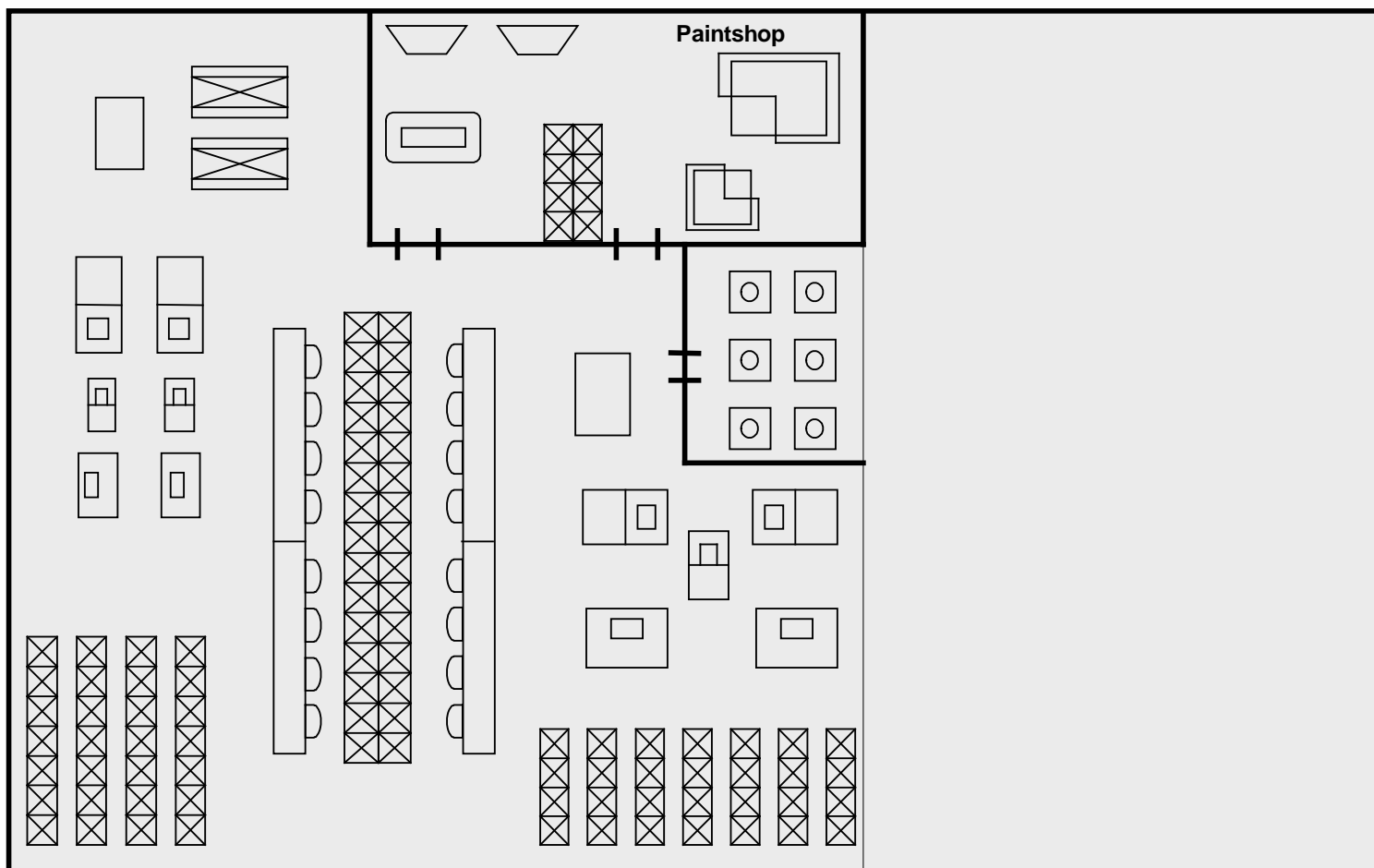
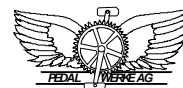
?: Check






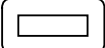







# Annex 3: Layout after modifications

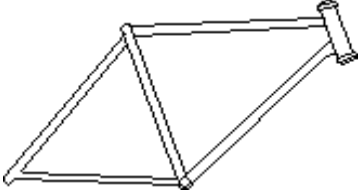
Frame-production Pedal Works Ltd.

Layout after the reorganization



- |   |  |   |  |   |  |
|---|--|---|--|---|--|
|  Punching machine |  Soldering device |  Milling machine   |  Storage          |  Stencil shop    |  Painting furnace |
|  Lathe            |  Assembly table   |  Welding equipment |  Painting devices |  Washing machine |  |

# Annex 4: An empty form sheet for a Basic Process Analysis

Drawing 				
	<b>Name of Part</b>	Fitting and frame Alu	Part-Nr.	
	<b>Inspector</b>	Assistant, Executive producer	Date of inspection	12 May 200x

<b>Nr. of parts</b>	<b>Distance</b>	<b>Time</b>	<b>Symbol</b>	<b>Location</b>	<b>Activity</b>	<b>Worker</b>	<b>Machine</b>	<b>Mode of storage</b>	<b>Comments</b>

Table from: [Shingo](#)

X: Lot size caused waiting time \* : Transport

& : Process

O : Waiting time

% : Check