

PRINCE OF SONGKLA UNIVERSITY
FACULTY OF ENGINEERING

Mid-term Examination: Semester II

Academic Year: 2009

Date: December 19, 2010

Time: 9:00-12:00.

Subject: 225-503 Production Systems & Management Room: S203

Instructions

- Answer all 6 questions in the **answer**-book provided
- Open-book exam. Any materials, books, papers, calculators and dictionaries are allowed.
- Total score is 100

Questions	Full Score	Assigned Score
Q1	10	
Q2	30	
Q3	15	
Q4	20	
Q5	10	
Q6	15	
Total	100	

Assoc. Prof. Somchai Chuchom

ทฤษฎีในการสอบ โทษขั้นต่ำคือ ปรับตกในรายวิชาที่ทฤษฎี และพักการเรียน 1 ภาคการศึกษา



Question 1 (10 marks)

For the “Minimum structure” MS Block diagram supplied in Figure 1,

1.1 Link the in-and outputs (x_{ij}, y_{ij})

1.2 Draw the corresponding “Basic MS Structure Matrix”

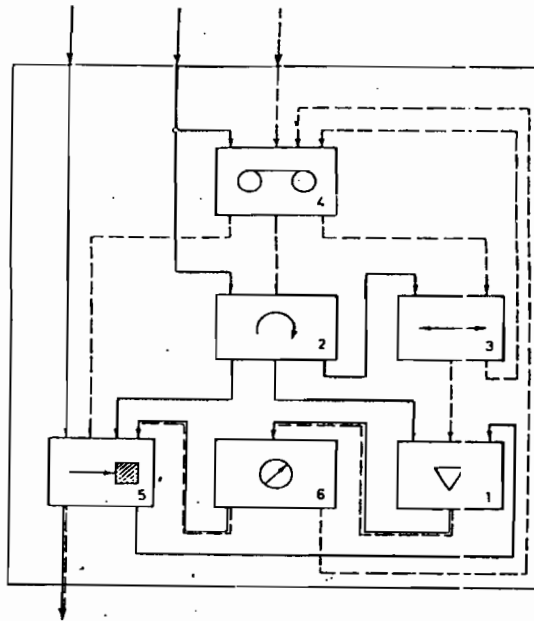


Figure 1

Question 2 (30 marks)

Materials and Manufacturing processes are involved in manufacturing systems. Classify them and explain each of them in briefly. Choose a specific manufacturing process, discuss in details on its characteristics, technologies, machine tools involved and applications.

Question 3 (15 marks)

If you were asked to manufacture a high precision automobile shaft, where quality and production rate are of primary concern, which process or processes would you choose? Discuss your answer.

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Question 4 (20 marks)

In general, there are four classes of manufacturing attributes which are considered when making manufacturing decisions: cost, time, quality and flexibility. Give some simple examples for each class of these attributes, and discuss how to make decision on specifying the values of the relevant manufacturing attributes.

Question 5 (10 marks)

A typical life cycle of a product is shown in Figure 2. How can you make use of this information in manufacturing system?

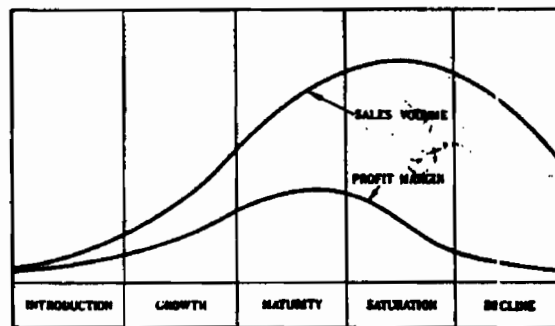


Figure 2

Question 6 (15 marks)

Read the article 'The Toyota Production System' in the APPENDIX provided, then answer the following questions.

6.1 What is TPS? What does it mean for suppliers and for the future of auto industry?

6.2 What is Toyota's DNA? How to make it evolve worldwide?

6.3 What you have learned from this article related to manufacturing systems?

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APPENDIX

TMMK Toyota Motor Manufacturing Kentucky Inc.

ABOUT | MANUFACTURING | VEHICLES | COMMUNITY | ENVIRONMENT | HYBRIDS | TOURS | T/MS



The Toyota Production System

The "Thinking" Production System: TPS as a winning strategy for developing people in the global manufacturing environment

At the 2003 Automotive Parts System Solution Fair held in Tokyo, June 18, 2003, Teruyuki Minoura, Toyota's managing director of global purchasing at the time, talked about his experiences with TPS (the Toyota Production System), and what it means for suppliers and for the future of the auto industry.

At the 2003 Automotive Parts System Solution Fair, held in Tokyo, June 18, 2003, Teruyuki Minoura, then-managing director of global purchasing, Toyota Motor Corporation, talked about his experiences with TPS (the Toyota Production System), and what it means for suppliers and for the future of the auto industry.

Teruyuki Minoura is confident that the long-standing principles of the Toyota Production System will not change in the future, and that TPS will be able to meet any challenge. He noted that the system originally emerged through a trial-and-error approach aimed at solving practical problems and meeting the needs of the company. Recalling painful memories of the labor dispute of 1950 that destroyed so many friendships, he observed, "Businesses suffer if efforts are devoted to raising productivity when the products themselves cannot sell." It was through such experiences, that the basic concept of just-in-time was born.

In simplest terms, Just-in-time is "all about producing only what's needed and transferring only what's needed," says Minoura. Instead of the old top-down "push" system, it represented a change to a "pull" system where workers go and fetch only what is required. Tools, including the *kanban* (information card), *andon* (display board), and *poka yoke* (error prevention) were developed to implement the pull system. But, Minoura warns "simply introducing *kanban* cards or *andon* boards doesn't mean you've implemented the Toyota Production System, for they remain nothing more than mere tools. The new information technologies are no exception, and they should also be applied and implemented as tools."

Early in his career, Minoura worked under Taiichi Ohno, recognized as the creator of the Toyota Production System. Ohno, through tireless trial and error, managed to put into practice a "pull" system that stopped the factory producing unnecessary items. But Minoura observes that it was only by developing this "loose collection of techniques" into a fully-fledged system, dubbed the Toyota Production System or TPS, that they were able to deploy this throughout the company.

A "pull" system asks workers to use their heads

For Minoura, the way TPS develops people is its greatest strength. "Under a 'push' system, there is little opportunity for workers to gain wisdom because they just produce according to the instructions they are given. In contrast, a 'pull' system asks the worker to use his or her head to come up with a manufacturing process where he or she alone must decide what needs to be made and how quickly it needs to be made."



Teruyuki Minoura, Senior Managing Director, Chief Officer of Business Development Group & Purchasing Group. Mr. Minoura's previous position was managing director of global purchasing, Toyota Motor Corporation. He also served as president and CEO of Toyota Motor Manufacturing NA from 1998 to 2002.

(Photo courtesy of Nikkan Kogyo Shimbun)

Manufacturing >

Manufacturing Home
Toyota Production System
TPS Terminology
Global New Body Line
Global Production Center
The IMV Project



A modern Toyota assembly line

"An environment where people have to think brings with it wisdom, and this wisdom brings with it *kaizen* (continuous improvement)," notes Minoura. "If asked to produce only one unit at a time, to produce according to the flow, a typical line worker is likely to be flummoxed. It's a basic characteristic of human beings that they develop wisdom from being put under pressure. Perhaps the greatest strength of the Toyota Production System is the way it develops people." This is why when Minoura explains TPS, he says that the T actually stands for "Thinking" as well as for "Toyota."

In TPS, the T also stands for "Thinking"

Recalling being asked to solve problems by Ohno, Minoura says, "I don't think he was interested in my answer at all. I think he was just putting me through some kind of training to get me to learn how to think." Similarly, The Harvard Business School uses the case-study method as the best way to develop business thinkers. The Harvard professors never tell students the answer because, again, that is not the point. Minoura says, "Developing people is the starting point for *monozukuri* (making things) at Toyota."

To cut lead-time, cut out all the bits that don't add value

Implementing just-in-time production starts with reducing the lead-time for making things, according to Minoura. "The way to cut lead-time is to cut out all the bits that don't add value. There are only a few processes that actually involve processing. Most of the time stuff is just being transferred from place to place. If this causes a considerable lengthening in lead-time, aggressively getting rid of these bits where nothing is being processed is something that can be done right there right away."

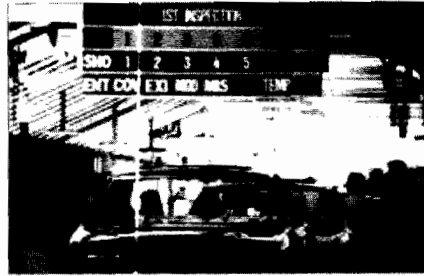


**2003 Automotive Parts System Solution Fair.
Keynote speech was attended by over 1,000.
(Photo courtesy of Nikkan Kogyo Shimbun)**

Next, one must get rid of defects. "If an item is defective, 'what's necessary' can't be delivered. If a defect is spotted, the line must stop right there and steps must be taken to sort out the problem. This highlights the concept of building quality into the process." Minoura elaborates: "Producing what's needed means producing the right quantity of what's needed. The answer is a flexible system that allows the line to produce what's necessary when it's necessary. If it takes six people to make a certain quantity of an item and there is a drop in the quantity required, then your system should let one or two of them drop out and get on with something else."

The line must stop if there is a problem

It is essential to halt the line when there's a problem. "If the line doesn't stop, useless, defective items will move on to the next stage. If you don't know where the problem occurred, you can't do anything to fix it. That's where the concept of visual control comes from. The tool for this is the *andon* electric light board."



Andon electric light board

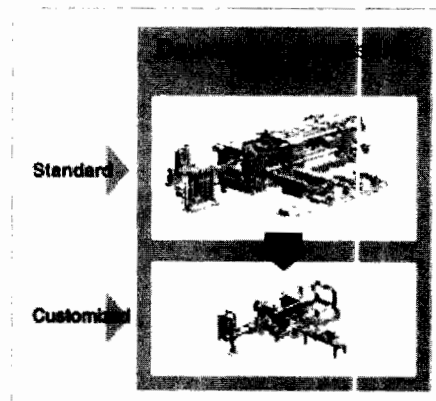
Deal with defects only when they occur, and the number of staff you need will drop

Standardized work is essential to identifying where things go wrong, Minoura says. "If you're turning out something in a different way from that on the standardized work sheet, or different from the way other people are doing it, that's the definition of a problem. By thinking about what is causing the problem, the problem itself will come into view. When the problem becomes clear this will lead to *kaizen*. If you make it a rule to deal with defects only when they occur, the number of staff you need will drop straight away. Things that are running smoothly should not be subject to any control. If you commit yourself to just finding and fixing problems, you'll be able to carry out effective control on your lines with fewer personnel."

Ask yourself "Why?" five times

When an error occurs, the first thing that needs to be done is fix the error. Minoura recalls that Ohno used to order them to ask the question "Why?" five times over because "that way you'll find the root cause, and if you get rid of that it'll never happen again." However, Minoura emphasizes that on-the-spot observation rather than deduction is the only correct way to answer a "Why?" question. "I'm always struck that the five-why method doesn't seem to be working as well as it should be because there's been a lack of practical training. The reason is that they end up falling back on deduction. Yes, deduction. So when I ask them 'Why?' they reel off five causes as quick as a flash by deduction. Then I ask them five whys again for each of the causes they came up with. The result is that they start falling back on deduction again, and so many causes come back that you end up totally confused as to which of them is important."

"Through real training," Minoura says, "you'll be able to discover dozens of problems and also get to their root causes. You'll be able to make dozens of improvements. If you incorporate all the accumulated knowledge of root causes that you've got from always asking 'Why? Why? Why? ...' into your equipment, you're going to have something that no one else can come close to. I don't think it's got anything to do with nationality; it all has to do with whether or not you've received the proper training. I feel though that the tendency to give that kind of training and education forms the basis of Toyota's approach to *monozukuri*."



Improved die casting machine, developed by Toyota, is customized to reflect the shape of the finished product, costs 50% less than its predecessor, and has one-third the production lead time.

(Source: TOYOTA Annual Report 2013)

Ultimately, the aim of TPS is to bring about lasting cost reductions. And the basic principles of TPS itself are not something that will change. But the world continues to change, and there are four ways Minoura suggests to cope with this.

First, when considering what factors allowed Japanese manufacturing to achieve global supremacy, Minoura notes that high quality was a key reason. "These days though, overseas carmakers and parts suppliers have come fairly close to reaching Japanese quality levels. This means that we've got to think really hard about what we have to do to maintain our preeminence in the area of quality."

Second, because the automaking business is becoming increasingly global, Minoura says, "It's important to shift our focus away from being Japan-centered to being more globalized, something which is also in line with our principle of *genchi genbutsu* (hands-on experience), and think about exactly what form this shift should take."

Third, Minoura thinks the future is going to see an increasing need to incorporate customer needs and wants into products. "It's necessary for suppliers to work with us at every stage to work out how we can produce better goods more cheaply. This kind of collaboration could bring with it the fresh ideas we need."

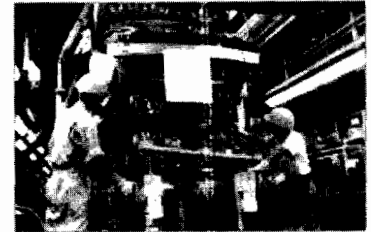
John

Finally, Minoura says that "to allow Toyota's DNA to spread and evolve globally, we need to develop and train global people."

But efforts to build quality into the production process are becoming severely neglected, according to Minoura. "When we talk about defects in our factories, we are talking about defective processes. If there's a defective process, it's going to turn out defective products. However hard you examine a defective product, it doesn't improve the process. So we should focus on defective processes. Components move from supplier to supplier in a flow, and unless an excellent control system is in place, it's impossible to prevent defects from occurring. Establishing such a control system is easiest when the supply chain is simple. And that is something for which top management should take responsibility."

Train people to follow rules and standards as if second nature

Nevertheless, human beings are the ones who actually build quality into a product. "It's important to create a climate in which people are trained to follow rules and standards as if they were second nature," Minoura says. "This kind of reflexive response is a hallmark of Toyota's *monozukuri*."



Human beings build quality into a product

It is essential to build relationships of mutual trust. Minoura sees localization or *genchika* as key. "In the beginning of my stay in the U.S., we had to keep some functions back in Japan, but these days we are trying to get as much as possible done in the US. A key strategy now is personnel *genchika*. Successful *genchika* depends on how thoroughly we can get local employees to 'inherit' our Toyota DNA."

Find where a part is made cheaply and use that price as a benchmark

A basic goal is to keep increasing the level of local procurement. "If we find that there's a place in the world where they can produce this or that part for this or that price, we should use that price as a benchmark, and pour our efforts into finding a way to make it even more cheaply locally," Minoura says. "Personally, I think that's by far the best approach to take. If we can make the local parts cheaper, the incentive to buy from other markets will vanish. But to actually realize this, to actually say 'OK, they can make it for XXX dollars, so we've got to get it made cheaper here', requires collaboration between carmakers and suppliers. It's therefore the responsibility of us manufacturers to look at the cheapest price, and make every effort to find a way to produce for even less locally, even in Japan."



Using Toyota's V-Comm digital engineering technology, engineers in Japan and overseas work together to optimize production processes.

(Source: TOYOTA Annual Report 2003)

Minoura warns that suppliers need to shift their focus to the car user instead of the carmaker. "You are going to have to start analyzing the needs and wants of the end user. You're going to be finding out what end users want and working to develop suitable components. Then you're going to be offering what you've developed to carmakers like us, who are going to incorporate these components into our designs. That's the kind of shape that the industry is going to take. When that happens, terms like carmakers and suppliers will become inappropriate. The two will have come together as partners, and together develop high-quality, low-cost products that meet the needs of the end users. To survive, you are going to need to use knowledge you gain on the shop floor to trim costs, and to funnel the funds from those cost savings into development."

You need to put extra effort into knowing yourselves and knowing your competitors. You need to build structures that allow you to know your own strengths and benchmark them against those of your competitors."

Develop people who can come up with unique ideas

Minoura cannot overemphasize the leading role people play in *monozukuri*. "There can be no successful *monozukuri* (making thing) without *hito-zukuri* (making people). To keep coming up with revolutionary new production techniques, we need to develop unique ideas and knowledge by thinking about problems in terms of *genchi genbutsu*. This means it's necessary to think about how we can develop people who can come up with these ideas. As our operations become increasingly global, there's also a need to think how to implant the Toyota DNA in our overseas personnel."

Toyota exports its unique approach worldwide under the "Toyota Way" label. As part of this effort, the Toyota Institute was established in Japan in January 2002 to educate managers and executives from both Japan and overseas. "Each year," Minoura reports, "dozens of staff from our affiliates all over the world descend on Japan to learn the Toyota Way."

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