Sony's Implementation of Production Innovation Equipment and Manufacturing System Solutions

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Chapter 1

1. Introduction
   - 1.1 Shift in production needs
   - 1.2 Importance of demand oriented production
   - 1.3 Production innovation’s 3 main types of loss
   - 1.4 Cell production method

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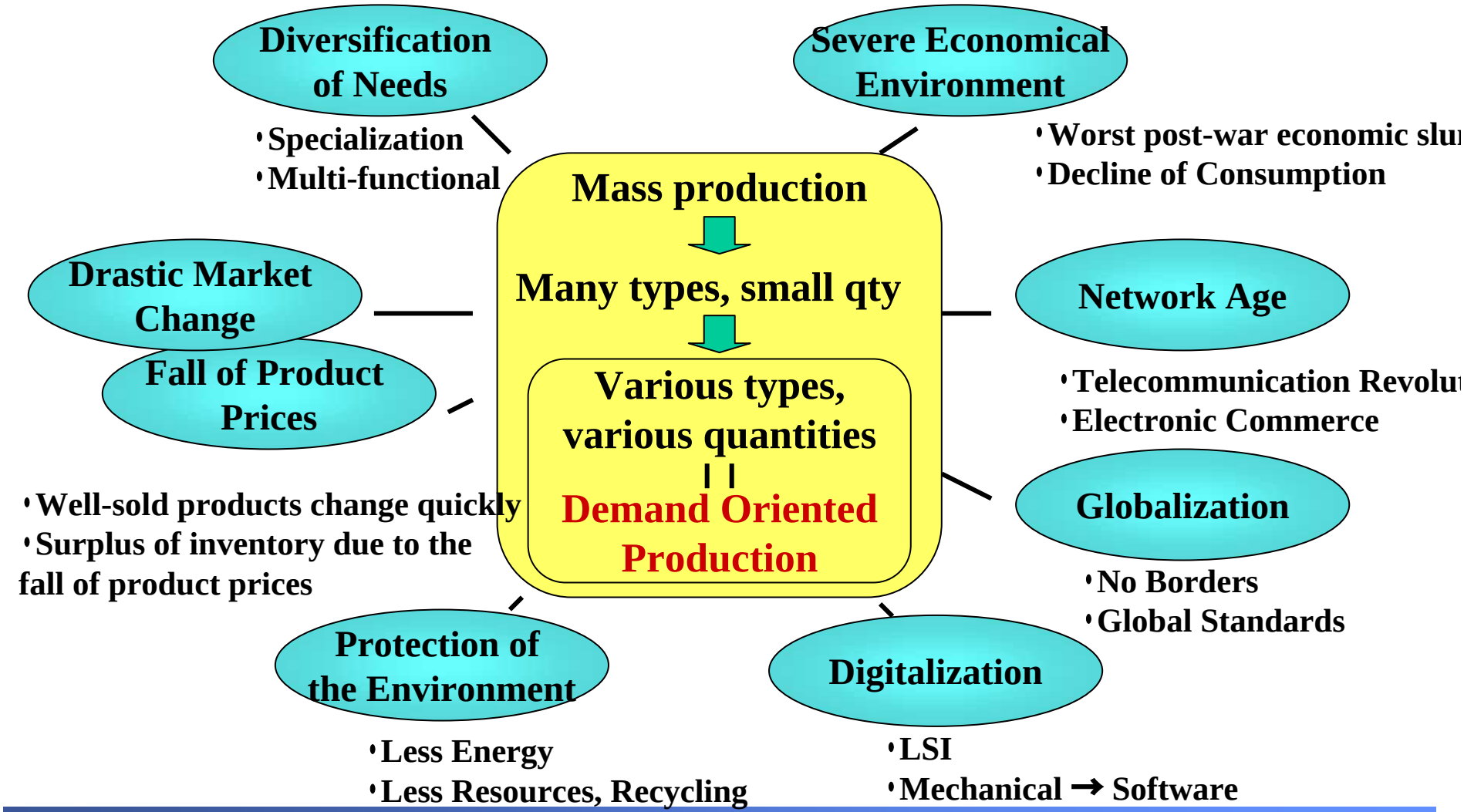
Shift in Production Needs



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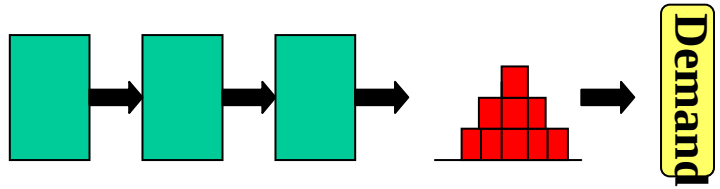
Importance of Demand Oriented Production

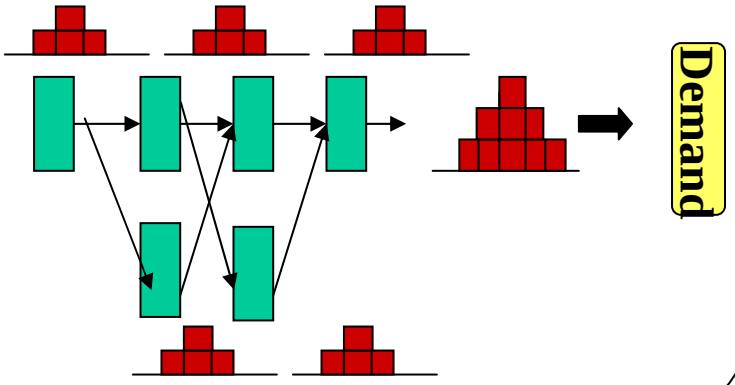
Sell what is produced

Large module type production line



✕ *Line change-over, model change*

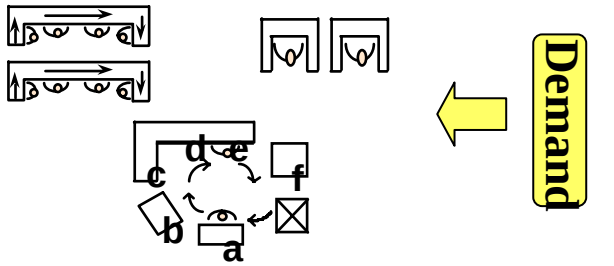
Batch-type production line



✕ *Lead-time, Inventory, etc.*

Produce according to demand

Various demand-oriented cell production lines



- Products which cannot be sold
- Change-over loss
- WIP loss
- Lead time
- Handling loss

Reduction

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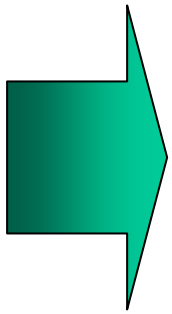
The Ultimate Production System

Cost
Investment
Lead time
Inventory
Space
Change-over loss
Rejected products
Breakdown

Minimization



Zero

Implementation of Production Innovation

Only make the required products at the required time

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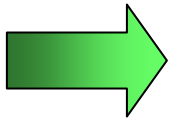
Production Innovation's 3 main types of loss

1. Handling loss

2. Transportation loss

3. Stagnation loss



Minimization of non-value added resources

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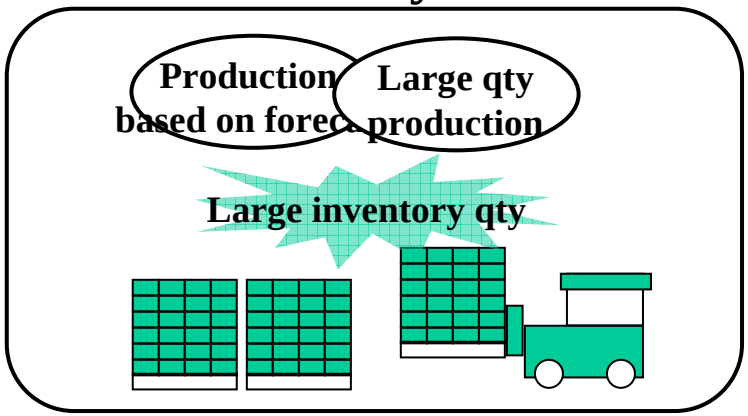
Progress by Production Innovation (1)

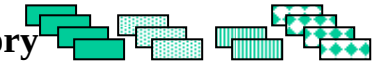
■ Production style



Innovation

Small Lot Production

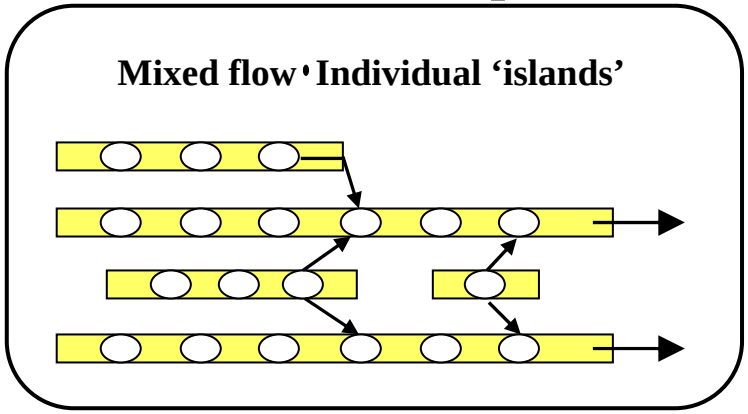
Target:
Zero Inventory



Customer's Required products
Required time
Required qty

Reduced funds turnover
Reduced space
Reduced control costs

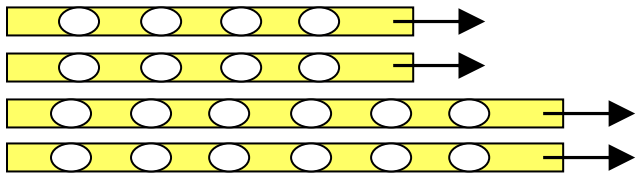
■ Flow-oriented production, information



Innovation

Flow-oriented
In-line

Reduction of WIP
Reduction of handling
Simplified quality tracking



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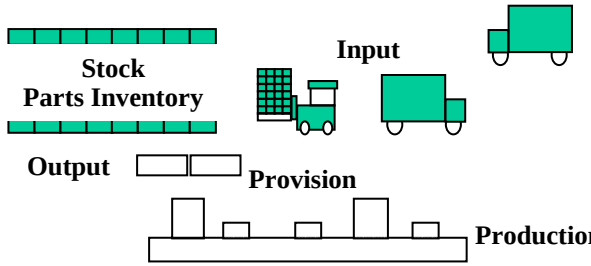
Progress by Production Innovation (2)

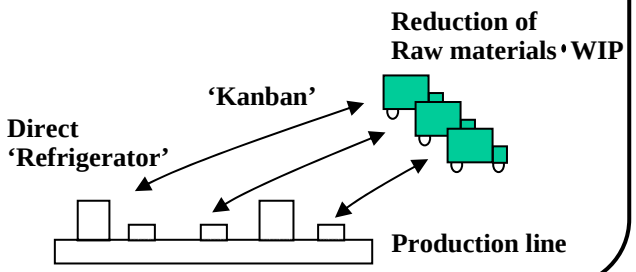
■ Inventory Reduction by Logistic Improvements

Large Order/Delivery of Parts
Push style provision



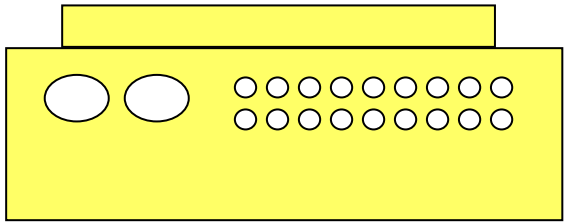
Innovation

Small qty order/delivery
Deliver only what is used



■ Manufacturing equipment

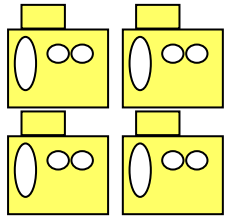
Large-size・High speed・High performance・High price



Innovation

Small size・Low-medium speed・Functional・Low price

WIP reduction by production leveling



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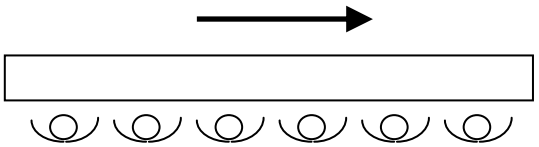
Progress by Production Innovation (3)

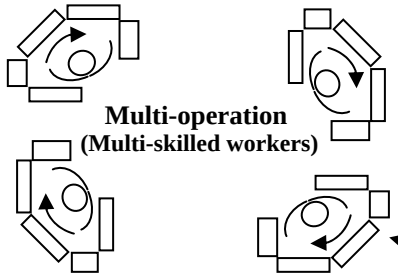
■From single operation to multi-operation

Divided labor conveyor production style due to single operation



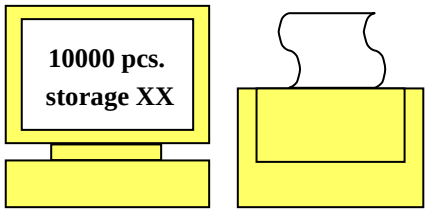
Innovation

Multi-operation and Cell production method



■Control comprehensive for anyone

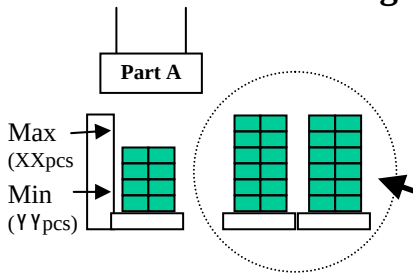
Data management by computer



Should be in storage ○ ○?
There should be ○○○○ pcs?

Innovation

Select&Order・Fixed place・Fixed qty・Fixed marking
Visual management



By seeing the abnormality, a quick response is possible

Abnormal !

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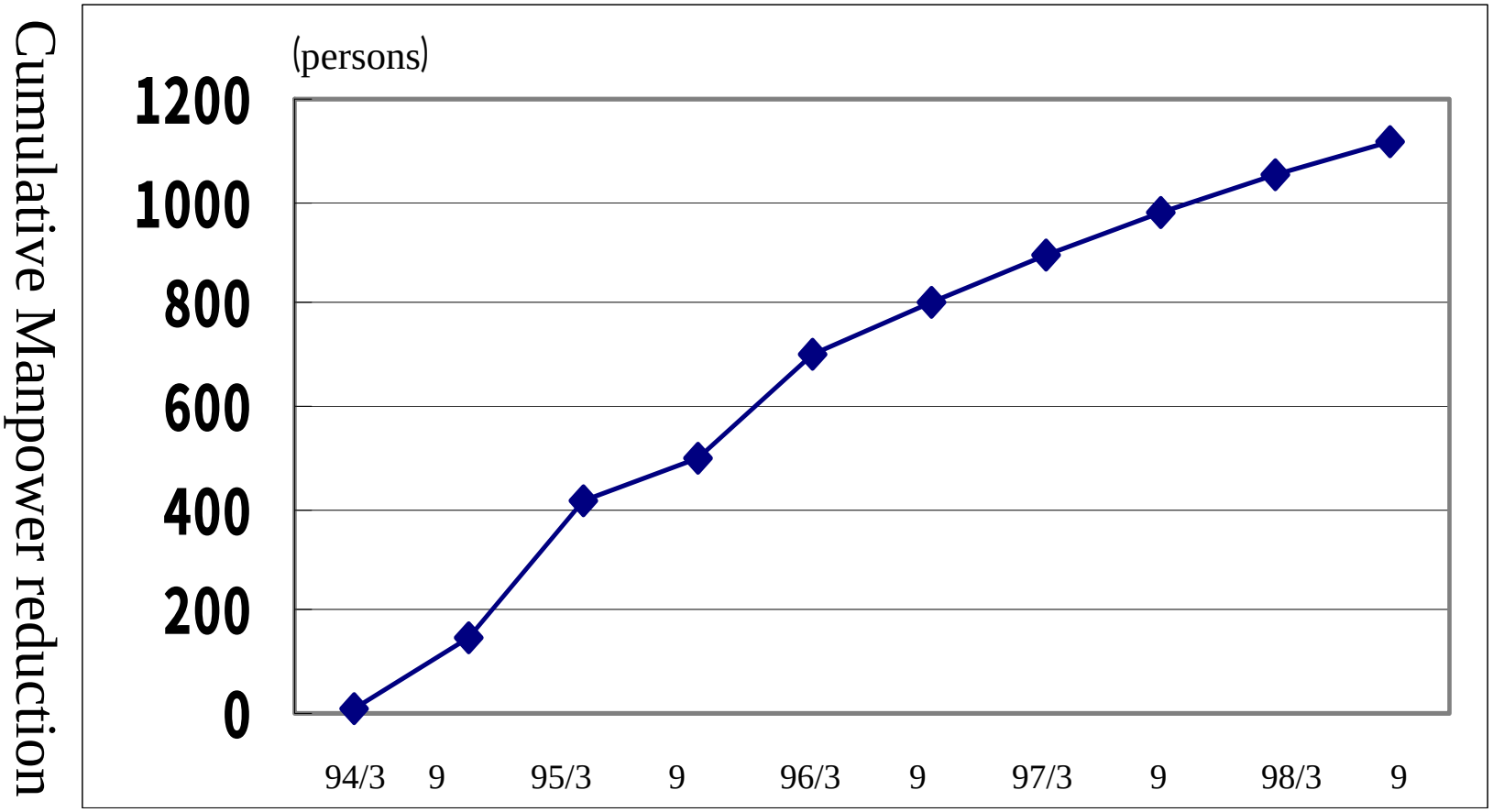
Example of Benefits of Production Innovation: Reduction of Manpower

(Actual factory example)



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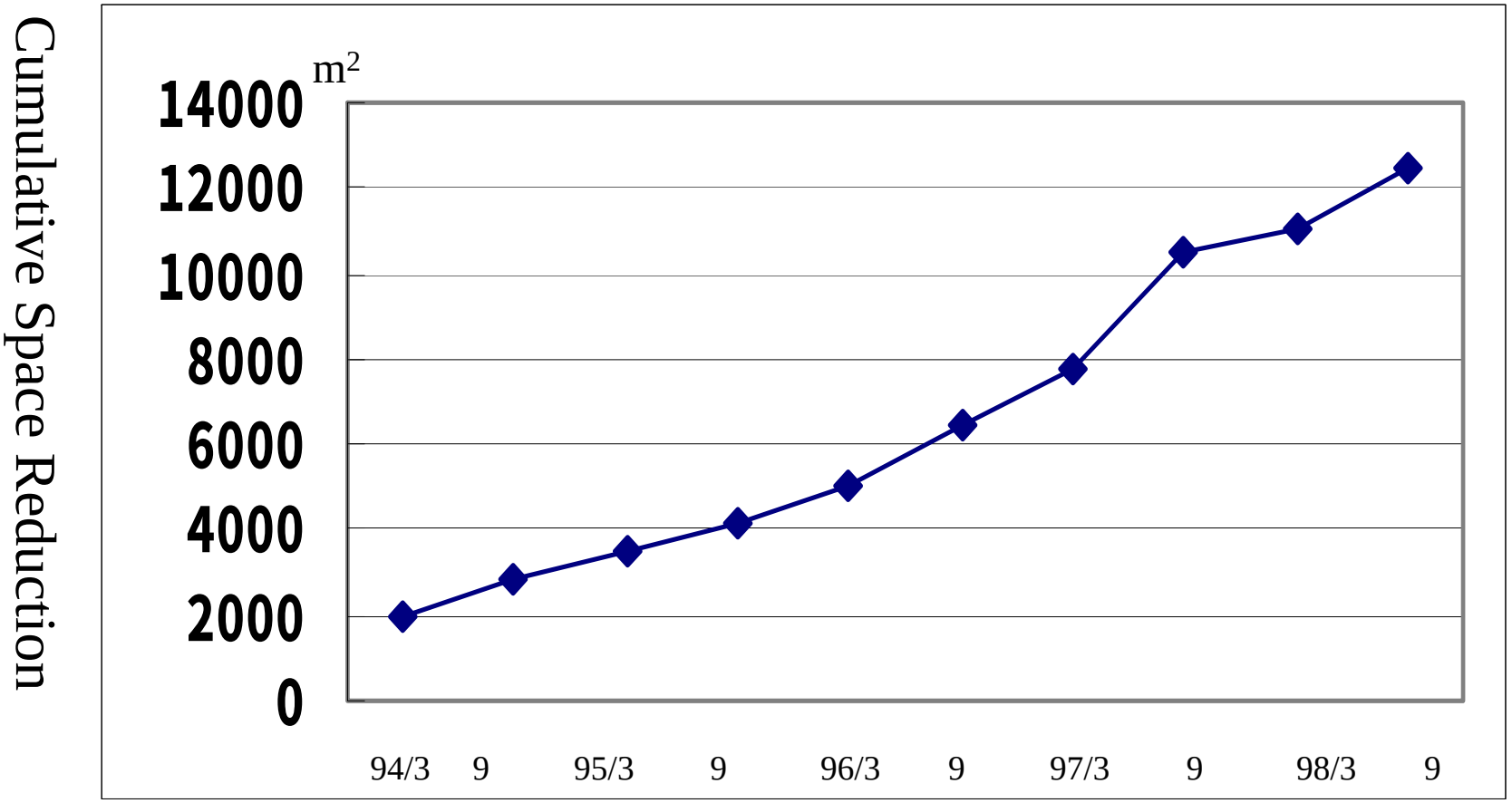
Example of Benefits of Production Innovation: Reduction of Space

(Actual factory example)



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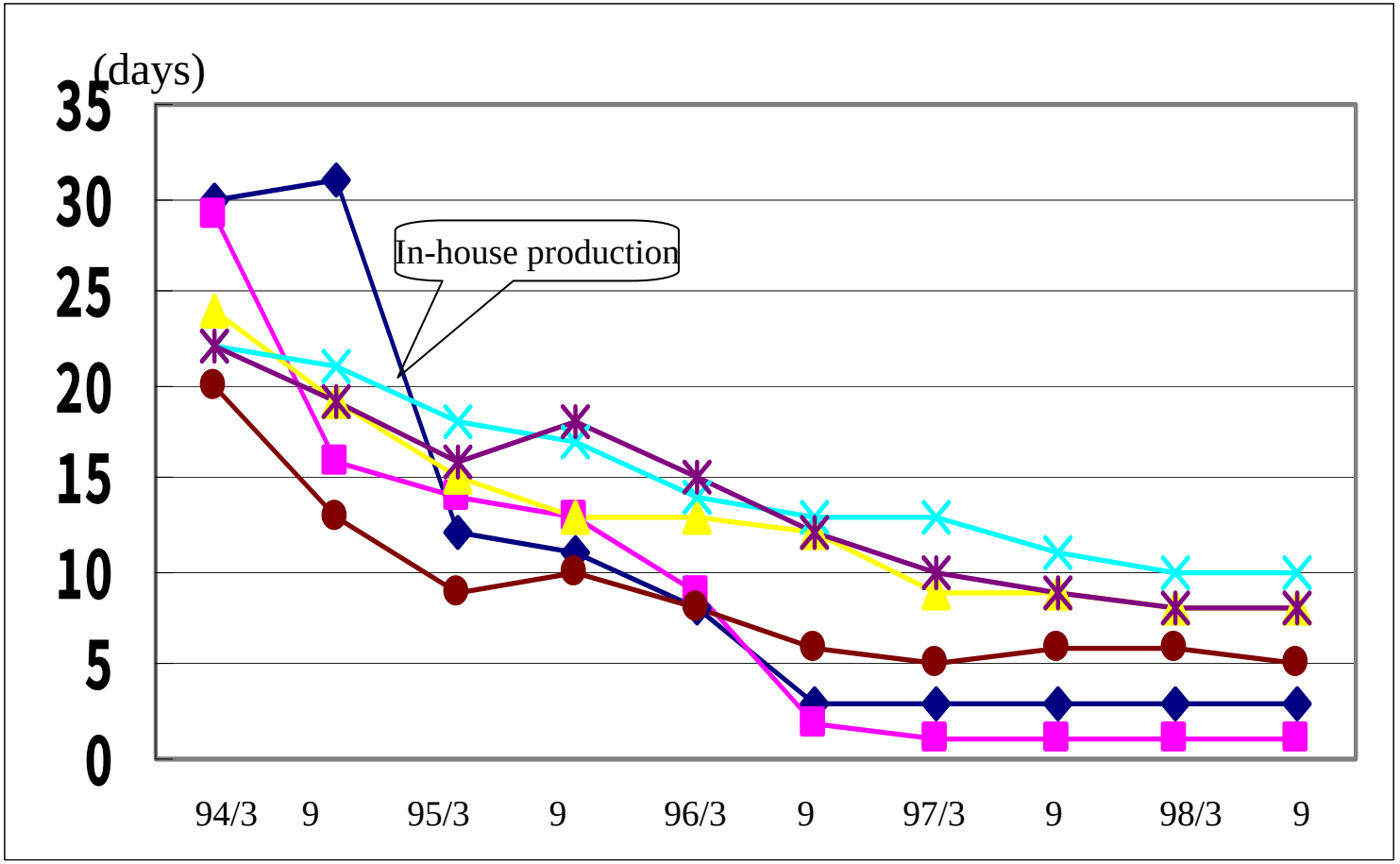
Example of Benefits of Production Innovation: Reduction of Lead time

(Actual factory example)



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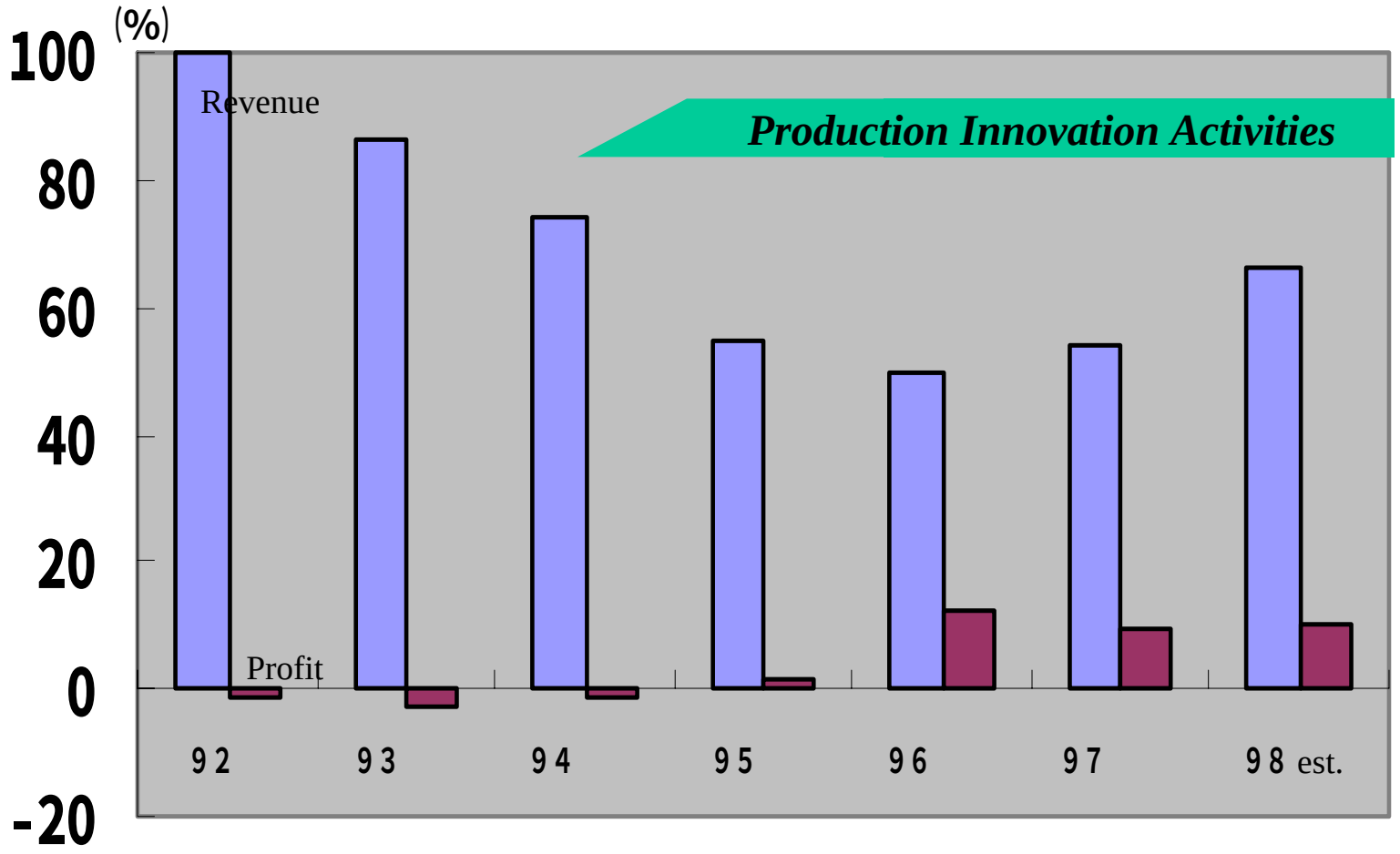
Example of Benefits of Production Innovation: Revenue&Profit

(Actual factory example)



Note) Ratio (%) with 1992 revenue as 100

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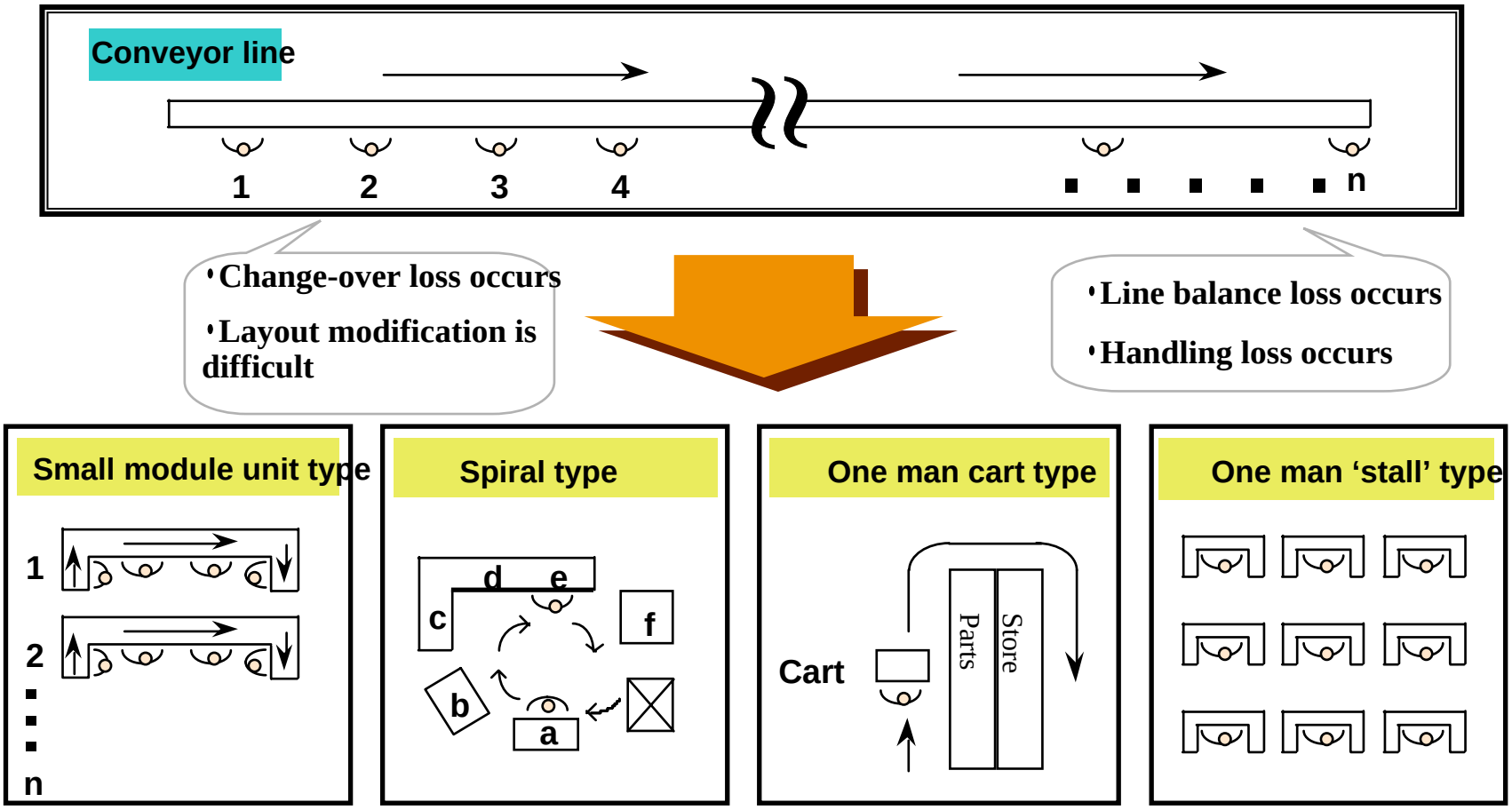
From conveyor line to various types of Cell Production



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Chapter 2

2. Benefits of Cell Production Method

2.1 Cell Production Method

2.2 Benefits of Cell Production Method

2.3 Examples of Cell Production Method

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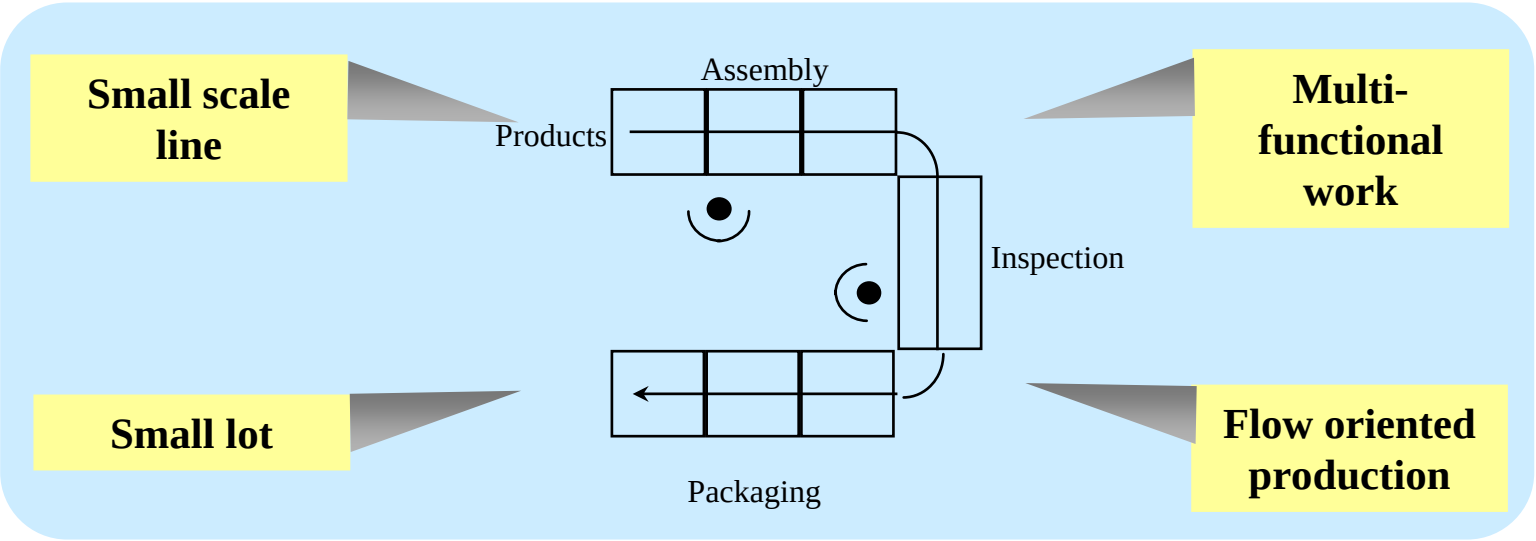
Cell Production Method

The Cell Production Method is one of the best solutions of manufacturing styles for small lot production, in which assembly and work are done in one single process, by using small manufacturing instruments (tools), by operation of one or a few workers.



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Example of Cell Production System

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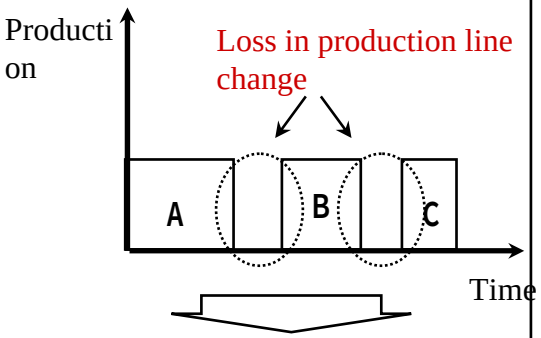
Benefits of Cell Production Method

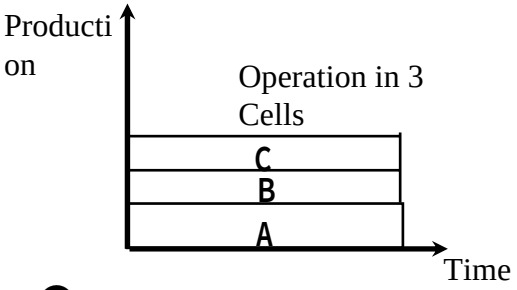
Flexibility Up

①Various items

Conveyor line



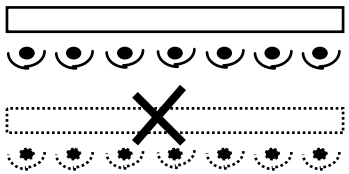
Cell production



●Cells by production type
●Production by sales speed

②Quantity fluctuation

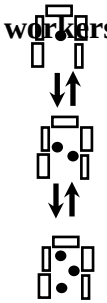
Conveyor line



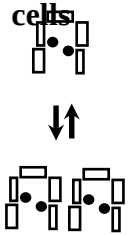
Line multiplication is difficult

Cell production

By number of workers

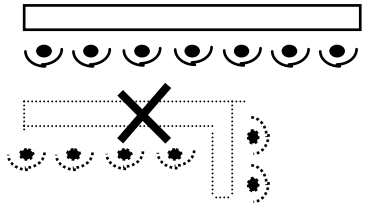


Bu number of cells



③Various layout

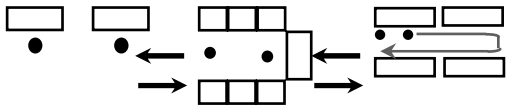
Conveyor line



Layout modification is difficult

Cell production

●Implementation of various cell types according to products attributes, level of operators, production quantity; layout modifications are possible flexibly



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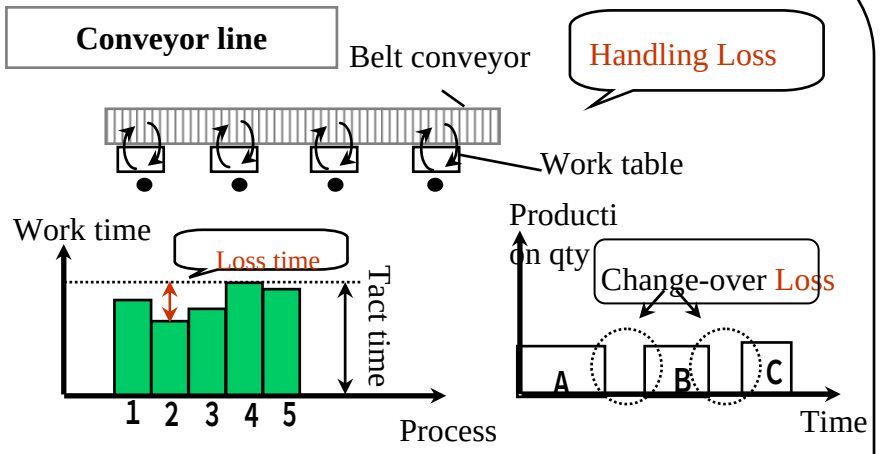
Benefits of Cell Production Method

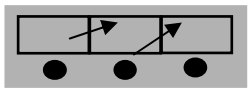
Manpower・Space reduction

①Productivity up → manpower reduction

Conveyor line



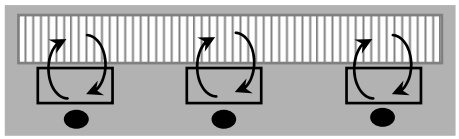
Cell production



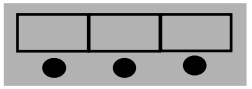
● Manpower reduction by elimination of conveyor line loss

②Space reduction

Conveyor line



Cell production



● **Space reduction by removal of conveyor**

● **Elimination of loss by reducing in-between spaces**

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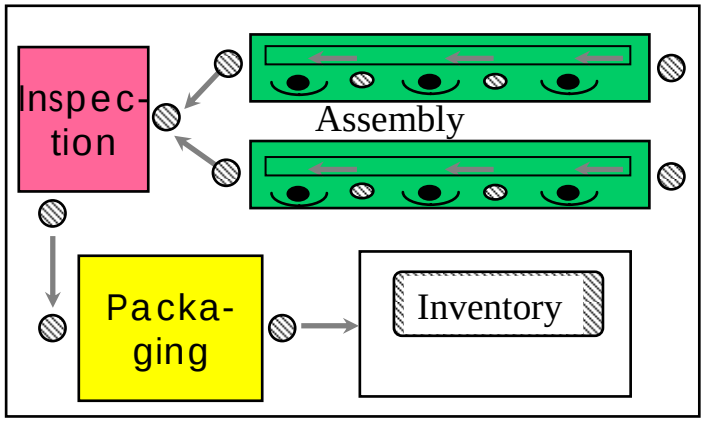
Benefits of Cell Production Method

Shortening of production lead time・Inventory reduction・Quality improvement

Conveyor Line



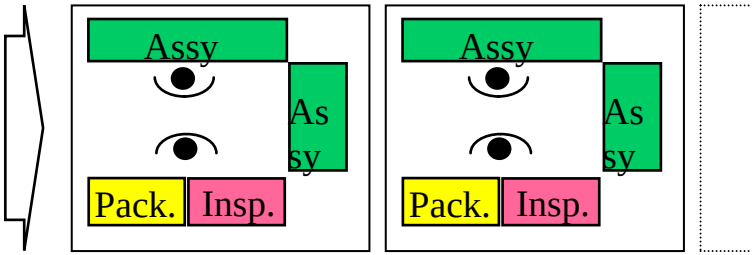
Stagnation of the products in process

Carry

- ✕ **Stagnation, transportation loss between or within processes**
- ✕ **Slow feedback of quality information**
- ✕ **Unclear responsibility concerning quality**

Cell production

Work cell



- ● **Reduction of stagnation in processes**
  → **Lead time reduction**
- ● **Reduction of inventory**
- ● **Fast feedback of quality information**
- ● **Clear responsibility concerning quality**
  → **Quality improvement**

Higher work morale by individual performance

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Chapter 3

3. Development of Production Innovation Equipment
   - 3.1 Role of Production Technology
   - 3.2 Codependence of Men and Machines
   - 3.3 Conditions of Production Equipment suitable for Cell Production
   - 3.4 Development of Innovation Equipment

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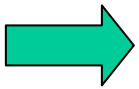
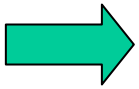
Role of Production Technology

"Produce products which have not been produced before"



Basic Technology Development which supports Products Excellence

"Further strengthening of Product Creation's QCD+F"



'Realization' Engineering which supports Manufacturing Excellence

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Codependence of Men and Machines

Role of the operator:

- **"efficiently operate production equipment"**
- **"make improvements to increase capacity"**
- **"make arrangements for next production models"**
- **"design systems"**
- **"make equipment, tools"**

} "Creation" work

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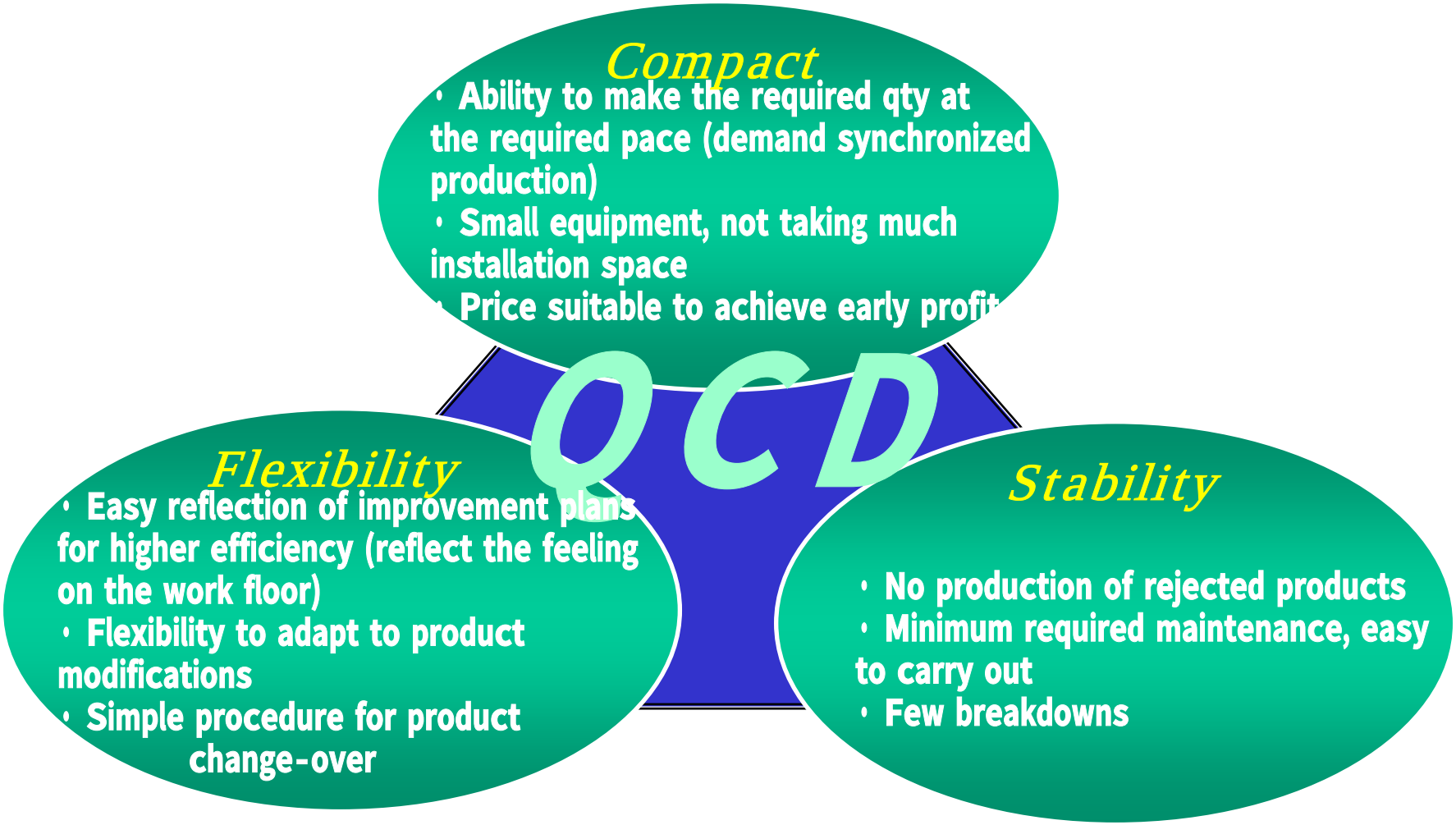
Conditions for Production equipment suitable for Cell Production Systems



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ROBOKIDS Makes Cell-Production Evolution Realized

Development Concept: 『*Compact*』
『*Minimum Cost*』

ROBOKIDS Sony Desktop Robot

Tool to Realize
"An Evolution of
Cell Production System"

Outstanding Features

① **Compact :** vs. conventional 1/4 （A4 size）
② **Cost :** vs. conventional 1/3
③ **Flexibility :** Wide Variety of Applications
(Soldering, Dispenser, Screw-Fastening, Circuit Board Splitting)

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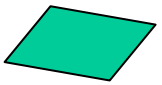
ROBOKIDS ~ Features ~

Conventional Type

ROBOKIDS
Sony Desktop Robot



A4-Size

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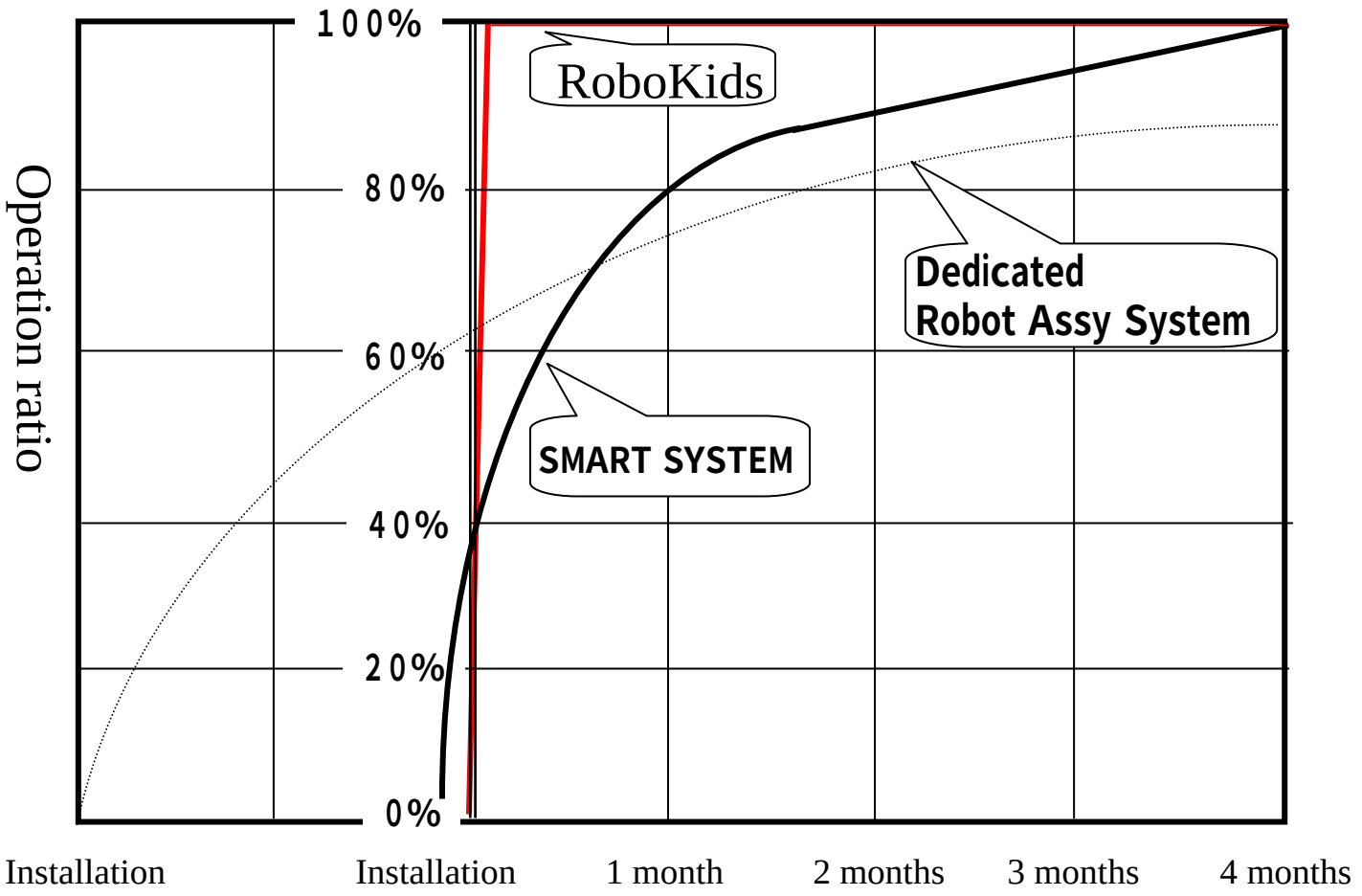
ROBOKIDS ~ Features ~

ROBOKIDS can be utilized from the Day of Installation



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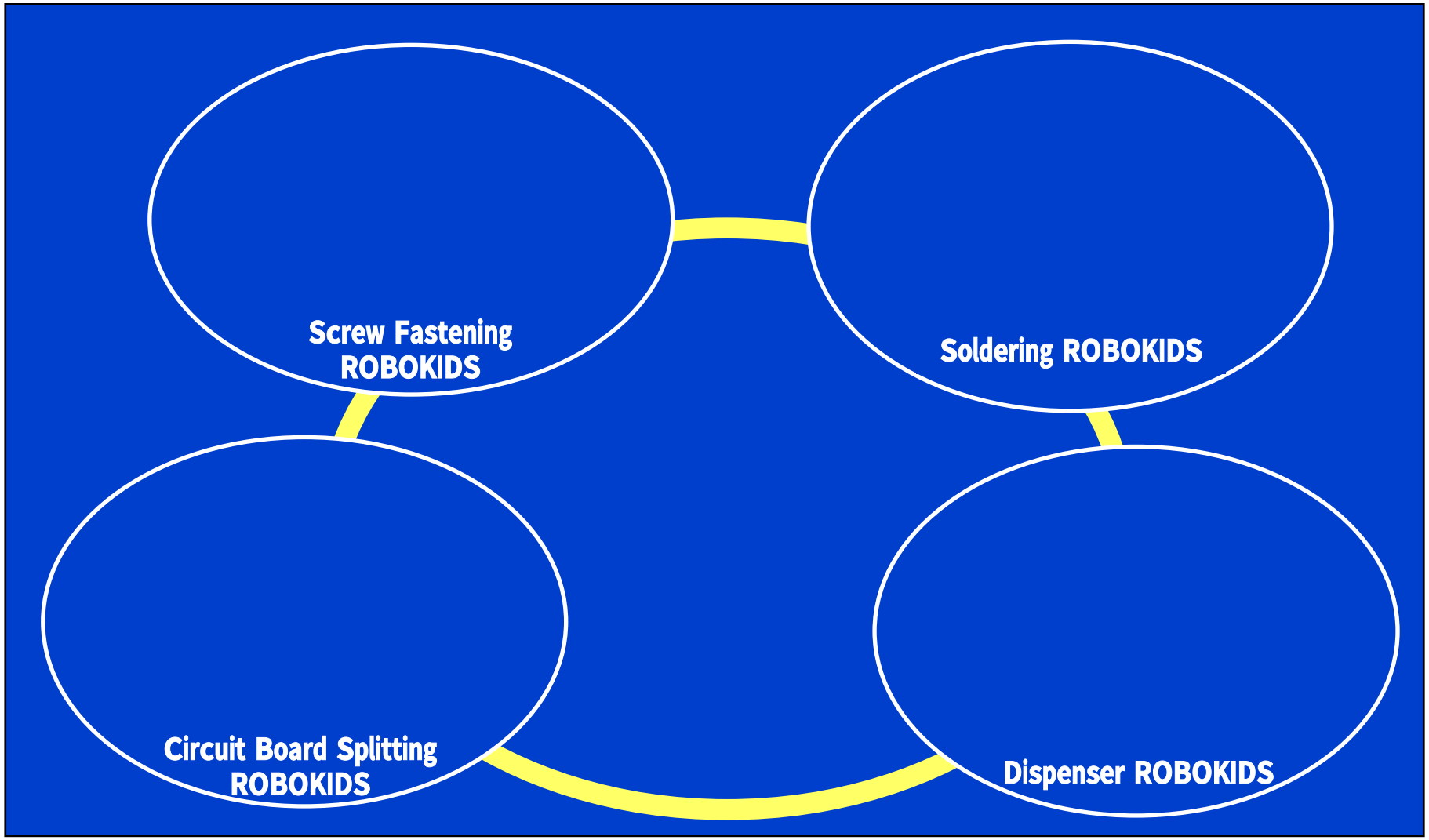
ROBOKIDS WORLD (Wide Variety)



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Actual condition at production factories

Flexibility is a main issue in the assembly area , as a starting point of production innovation, however in the surface mounting area …

- Very expensive mechanical equipment is lined up

- Large qty & high speed processing is a main objective, using identical models of high speed surface mounters

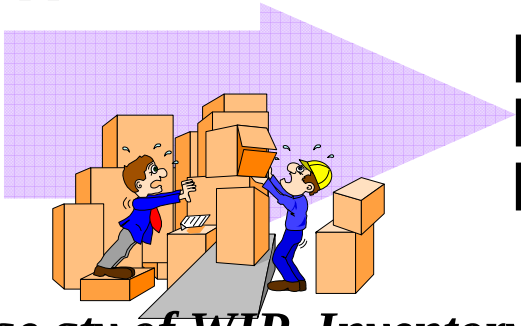
- Large scale equipment investment is still needed

"A mounting process, where production innovation is still difficult to introduce"

Large lot production

Mounting line(A)

Mounting line(B)



assy line(a) **assy line(d)**

assy line(b) **assy line(e)**

assy line(c) **assy line(f)**

Large qty of WIP, Inventory

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Objectives of the “Cellular Mounter”

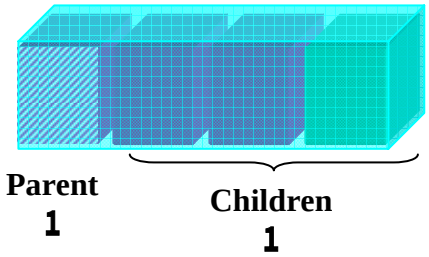
1) Compatibility of both high precision and flexibility

- ◆ Building is possible depending on demand variation, variation of production types
- ◆ Realization of low investment (cost/shot) ・ small space

2)Realization of Investment in steps to obtain a high level of investment results

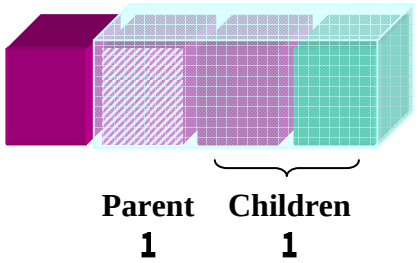
- ◆ Procure only the required function, at the required time, at the required level

Flexible Structure



<Standard type connection>

One machine is the parent unit and the other three machines are the children units



<PCB Mixed flow compatible>

One machine takes care of type-dependant parts, the other three machines are connected. (type change-over only for the first machine)

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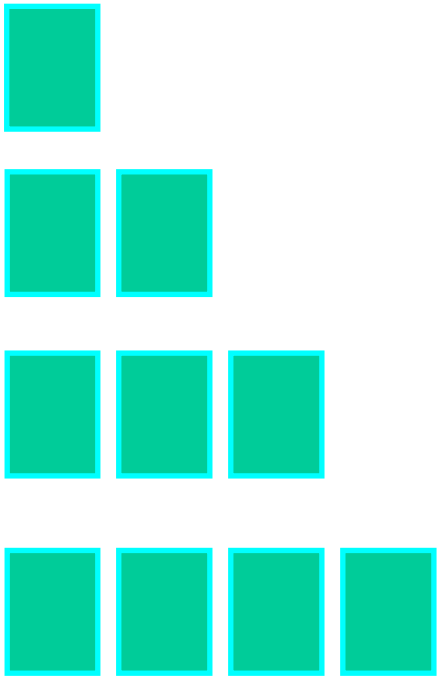
Flexible Production Capacity



= 12,857 cph in 1.2 m

= 25,714 cph in 2.4 m

= 38,571 cph in 3.6m

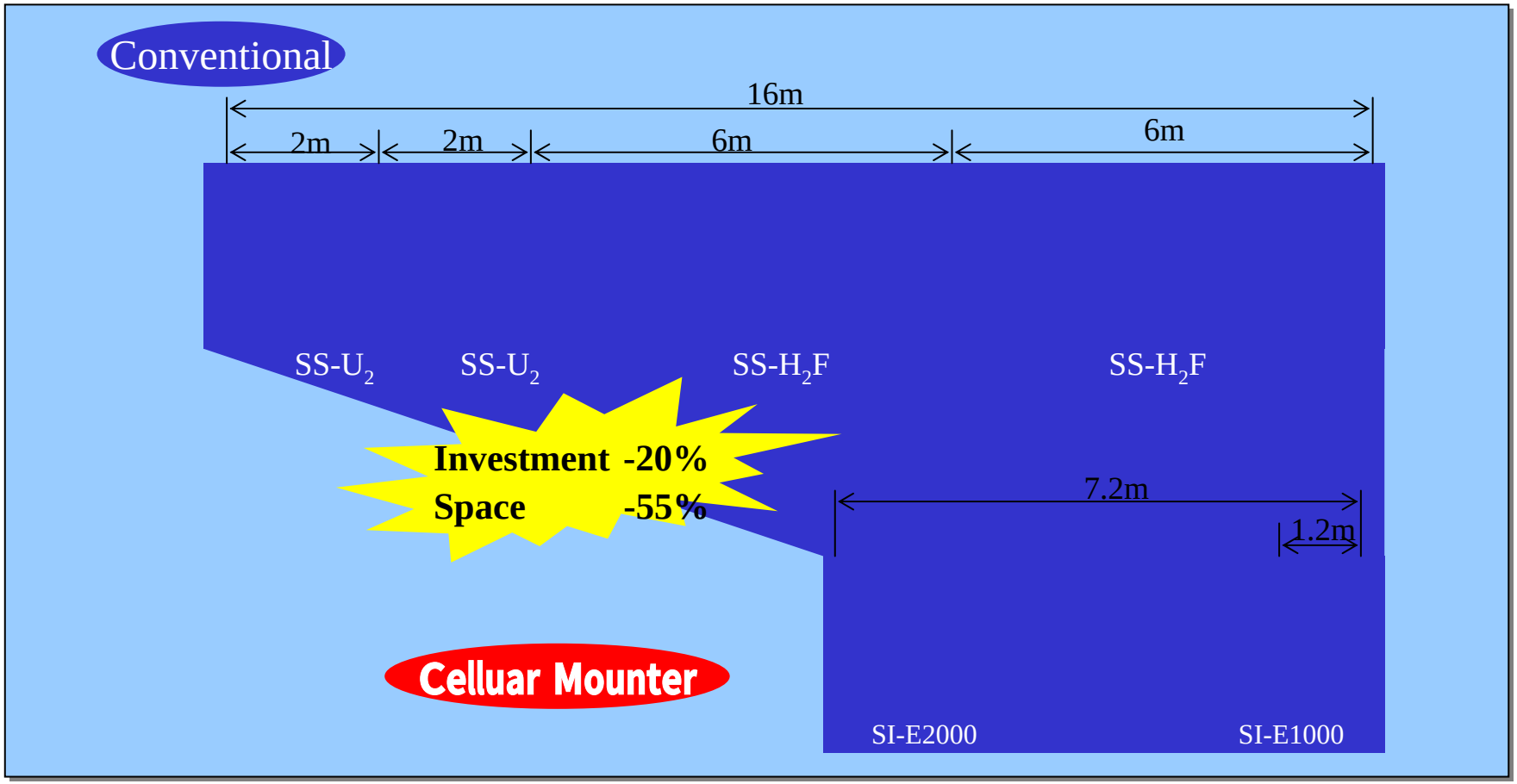
= 51,428 cph in 4.8m

Very Flexible!

SONY

Comparison of Conventional Mounters and Celluar Mounter

■ 20% Investment saving and 55% space saving is possible (per line)



Chapter 4

4. Manufacturing System Solutions

- 4－1 Total Plant Engineering
- 4－2 Points of Production Improvement
- 4－3 Evolution of Cell Production
- 4－4 Basic Design of Cell Production Line
- 4－5 Horizontal Implementation of Production Innovation Equipment
- 4－6 “SONY Cell” of Production Innovation Equipment
- 4－7 Summary

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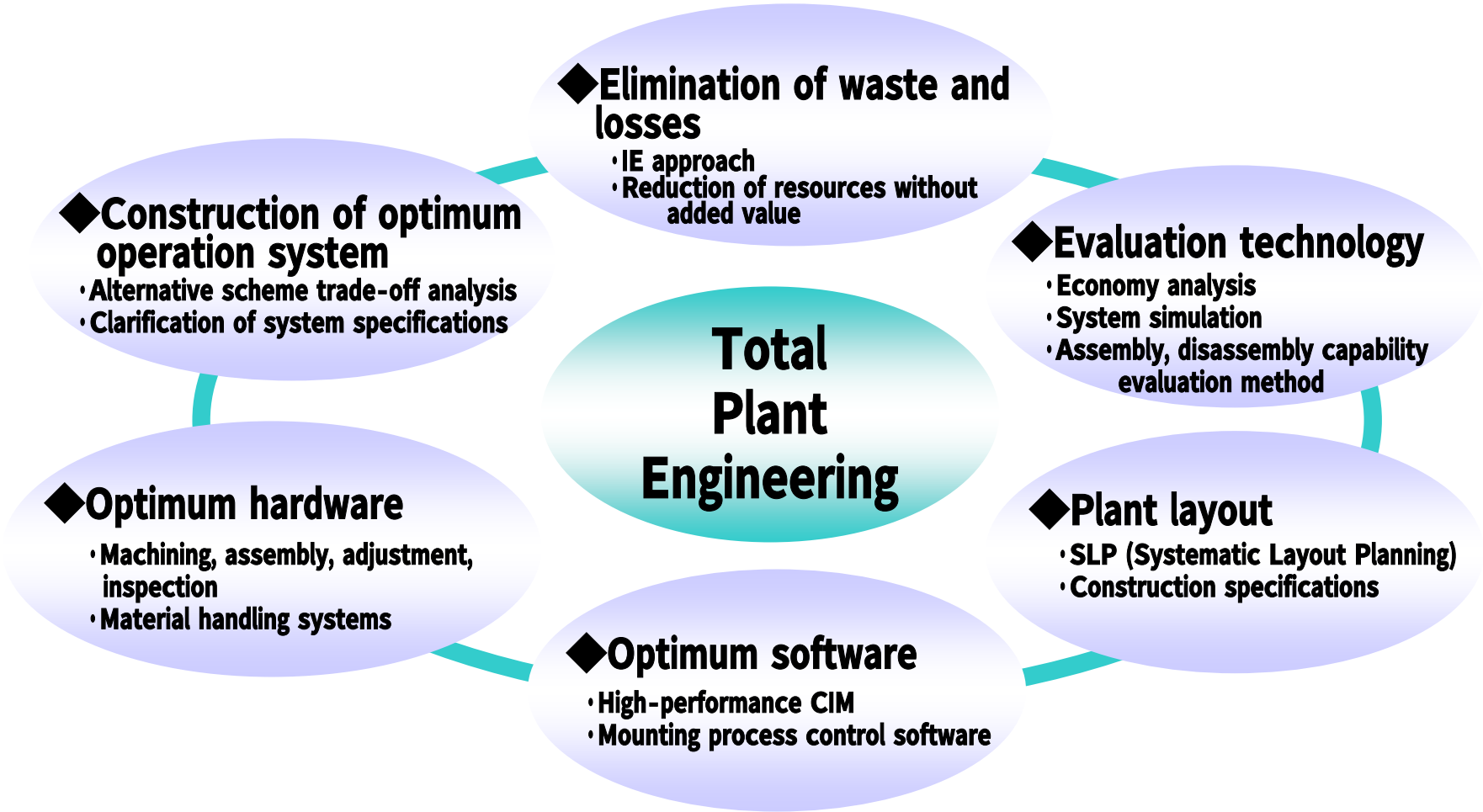
Total Plant Engineering



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Points of Production Improvement

1. Design for production: Design feedback using DAC method
   - Design with high 'manufacturability'
   - Reduction of number of parts
   - Standardization of parts
2. IE 'kaizen': Extensive elimination of 'muda' (loss) by production innovation
   - Transport
   - Operation
   - Stagnation
3. Factory automation: Low-cost, easy-to-maintain equipment

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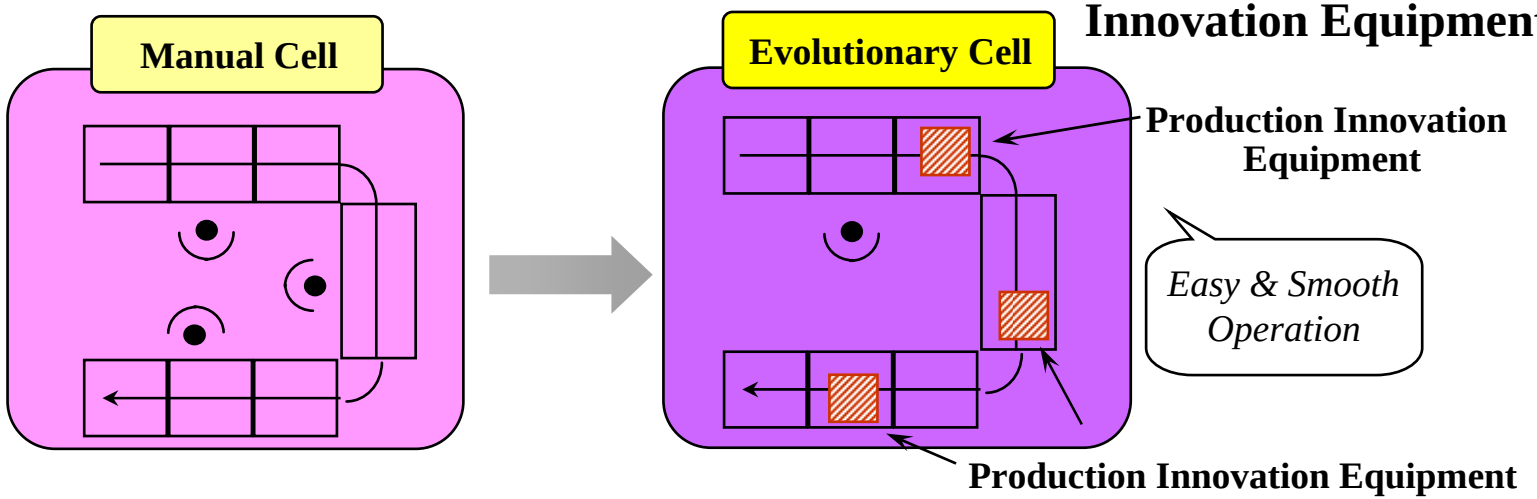
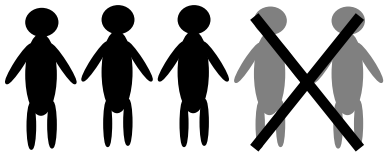
Evolutionary Cell Production System

Symbiosis of Human & Machine：Evolution of Cell Production by Production Innovation Equipment

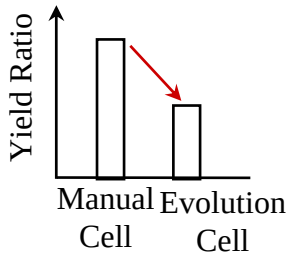


Benefits from Evolutionary Cell Production

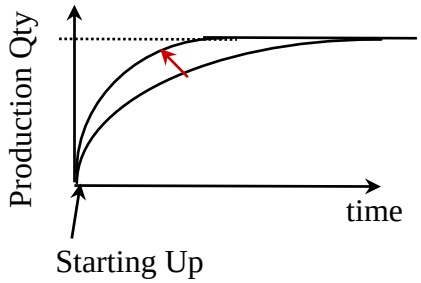
Headcount Saving



Quality Improvement



Reduction of Losses at Learning Stage



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Evolutionary Cell Production ~ Example ~

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Evolutionary Cell Production ~ Example ~

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Basic design of cell production line

1. Production oriented design: feedback to design by using DAC analysis

2. Summarized process organization

3. Layout image drawing

4. Application image using production innovation equipment

5. Profitability investigation

DAC Design for Assembly/Disassembly Cost-effectiveness

Features of Parts '' evaluates the shape and other characteristics of a part that determines the ease with which it can be fed and acquired (picked).

Features of Assembly '' evaluates the ease with which the part can be oriented, retained and assembled.

Features of Processing '' evaluates the ease with which the base part can be retained or turned over for the next operation.

Design with high 'assemblability'

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DAC Sheet

Assy-Ease diagram

Sh No	Assy order	Part name	Part number	Basic Operation	No. of P.	Orien	FOP	FOA	FOPr	Total	Standard Operation	Assy-Ease diagram
		chanical chassis		supply			0			0	0	100
		Alcohol		Rinse				20		20	20	80
		Peal Sheet		Insert			10	40	0	50	50	50
		Grease		Apply				30	0	30	30	70
		Moter-gear Assy		Insert			0	10	0	10	10	90
		0-Special Head S		Screw			0	20	0	20	20	80
		Deceleration Gear		Insert			0	10	0	10	10	90
		Cam Gear A		Insert			0	10	0	10	10	90
		Grease		Apply				20	0	20	20	80
		L-Moter Assy		Insert			0	20	0	20	20	80
		0-Special He		Screw			0	20	0	20	20	80
		Alcohol		Rinse			0	40	0	40	40	60
		Peal Sheet		Insert			10	30	0	40	40	60
		DEW Sensor		Insert			0	20	0	20	20	80
				Solder				40		40	40	60
		Cam Gear B		Insert			0	10	0	10	10	90
		Grease		Apply				40	0	40	40	60
		Grease		Apply				20	0	20	20	80
		Gear Cover A		Insert			0	20	0	20	20	80

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Assembly evaluation problems, summary of suggested improvements

No.	Part	Problem	Improvement	Points Before (After)	Design Comment
1	Pinch drive arm	Features of Assembly：Difficult positioning during insertion (-10) When placing Gear cover C on the Pinch drive arm, the Pinch drive arm moves, so positioning is difficult	Facilitate positioning by use of a positioning pin (+10)	90 (100)	Will be considered
2	Gear cover C	Features of Assembly：Difficult positioning during insertion (-10), Retain (-10) When placing Gear cover C on the Pinch drive arm, the Pinch drive arm moves, so positioning is difficult When screw fastening (next operation), retaining is needed	Facilitate positioning by temporarily fixing with a Positioning pin (+10) Facilitate positioning, and make retaining unnecessary when screw fastening (+10)	80 (100)	Will be considered
3	Gear cover A	Features of Assembly：Difficult positioning during insertion (-10) When placing Gear cover A, the connection with the Mode gear is complicated, so positioning is difficult	Facilitate positioning by use of a positioning pin (+10)	90 (100)	Will be considered
4	Drum base	Features of Part：During feeding, picking, situation is not completely stable (feed; -20、pick; -10) When inserting Coaster S, T in the Drum base, unstable situation	Make Coaster S,T difficult to remove by temporarily fixing (+30)	60 (90)	Will be considered
5	Retaining cover	Features of Assembly： Positioning difficult during insertion (-10), sliding occurs (-10) Features of Processing：Retain (-10) When attaching the Retaining board, positioning is difficult When screw fastening, retaining is necessary	Facilitate positioning by making temporary fixing points (+10) Facilitate positioning, and make retaining unnecessary when screw fastening (+10)	70 (90)	Will be considered
6	Drum	Features of Part：Caution needed for scratches, dirt(-20) Features of Assembly：Assembly direction is diagonally down(-20), Difficult positioning (-10) Features of Processing：Retain (-10), Turn[180 °] (-20) Positioning pin is impossible, assembly of Drum is difficult	Facilitate positioning by use of a positioning guide(+10)	20 (30)	Improvement impossible

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Process organization

Process organization (45 sec cycle cell)

ROBOKIDS screwing time:1 place [4.5sec/screw] +Input/output time[4sec]
ROBOKIDS gear supply time:1 place [8.0sec/1] +Input/output time [4sec]
ROBOKIDS grease application time:1 place [4.5sec/1] +Input/output time[4sec]
ROBOKIDS soldering time:1 place [3sec/place] +solder+Fixture Input/output[4sec]

【Mech.assy】

No	Operation	Time	KIDS	Cycle
MA1	Set Mode FPC in Labeling fixture	2.9		44.9
	Clean with alcohol	2.1		
	Peel off FPC Label and stick	4.9		
	Remove	1.7		
	Set in Phase adjustment fixture	2.9		
	Apply grease (1place)	2.0		
	Robokids Remove/Insert	2.0		
	Attach Mode gear		36.0	
	Attach Reduction gear			
	Attach Cam gear A			
	Attach Cam gear B			
	Robokids Remove/Insert	2.0		
	Mode gear screw fastening (1 place)	2.9		
	Apply grease to gear of L Motor Assy	2.3		
	Attach L Motor Assy	14.6		
	Screw fastening (1 place)	2.9		
	Remove	1.7		
MA2	Set in the Mech. Chassis fixture	2.9		43.7
	Cleaning with alcohol	2.1		
	Peel off FPC Label and stick	6.3		
	Stick DEW on	3.0		

【FPC assy】

No	Operation	Time	KIDS	Cycle
F1	Take fixture	2.6		42.6
	Attach Sensor	7.4		
	Take FPC, Peel off Label, Set into fixture	8.2		
	Attach TOP Sensor to fixture	4.9		
	Attach END Sensor to fixture, insert in FPC	4.9		
	Attach Cassette-IN Switch to fixture	9.7		
	Attach LED with tweezers	3.2		
	Remove	1.7		
F2	Insert fixture into Robokids	4.0		43.8
	Solder TOP sensor+END sensor+CIN switch (6 places)		43.0	
	Solder LED (2 places)			
	Solder connector (5 places)			
	Remove FPC from fixture	3.2		
	Attach Connector, set fixed fixture	4.9		
	Cut pins of TOP/END sensor with pincers	12.6		
	Take and Bend FPC	8.5		
	Attach FPC Holder			
	Screwing (2 places)	5.8		
	Remove fixture	4.8		

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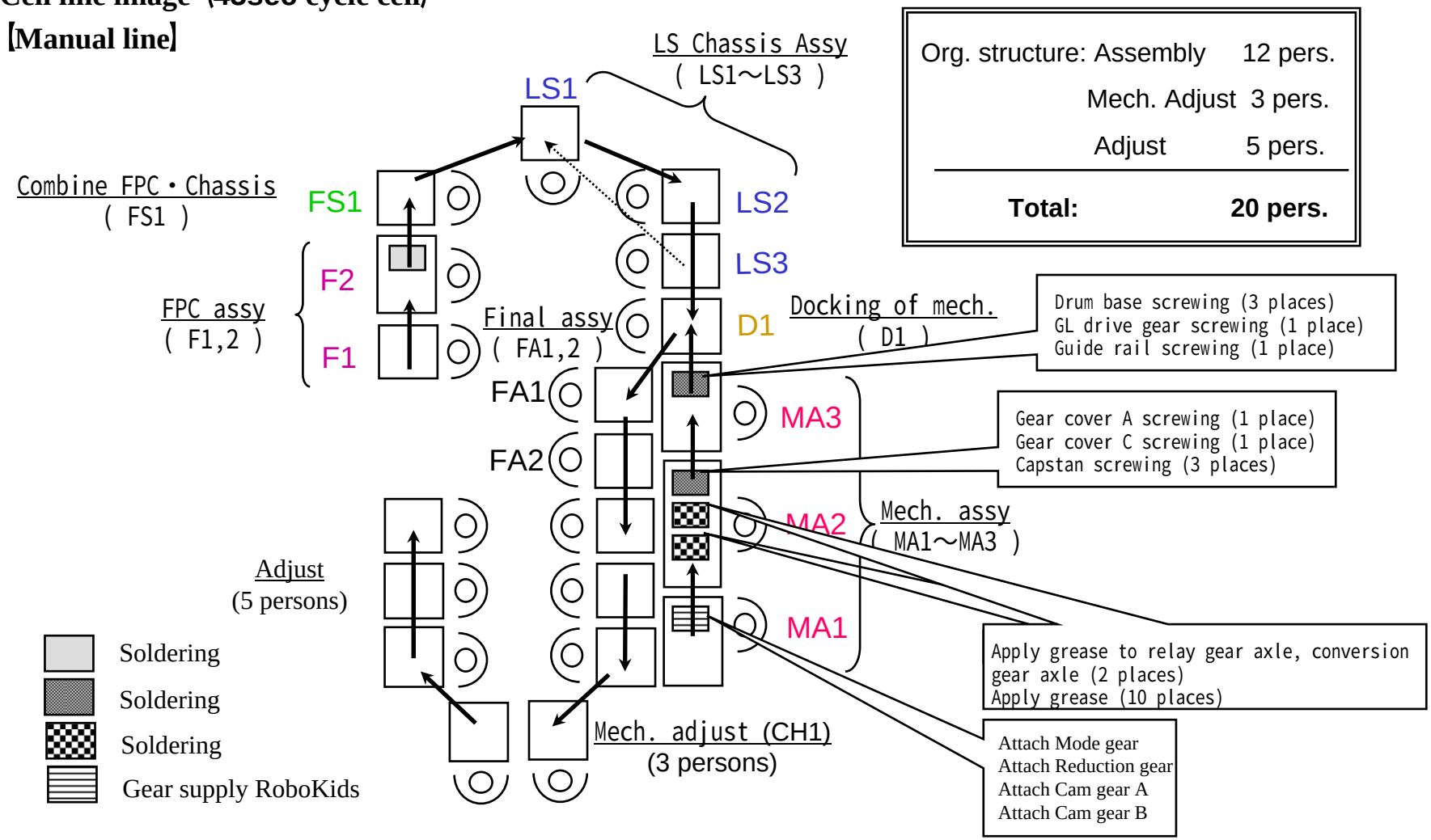
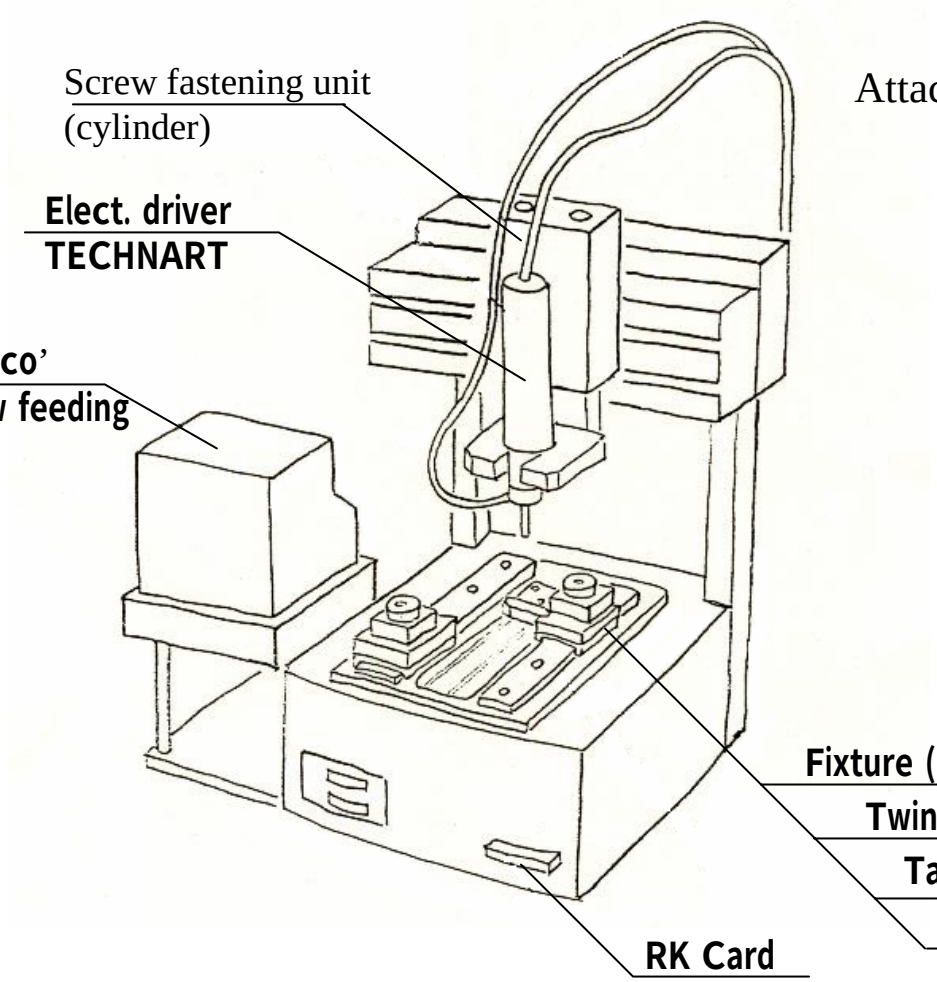
Cell line image

Cell line image (45sec cycle cell)
【Manual line】



Actual Application Example (Screw Fastener)



Attach Stator 3 screws  × 3

M 1.4

- Elect. driver : TECHNART
- Screw feeder : 'Nejicco'
- Table : Twin table

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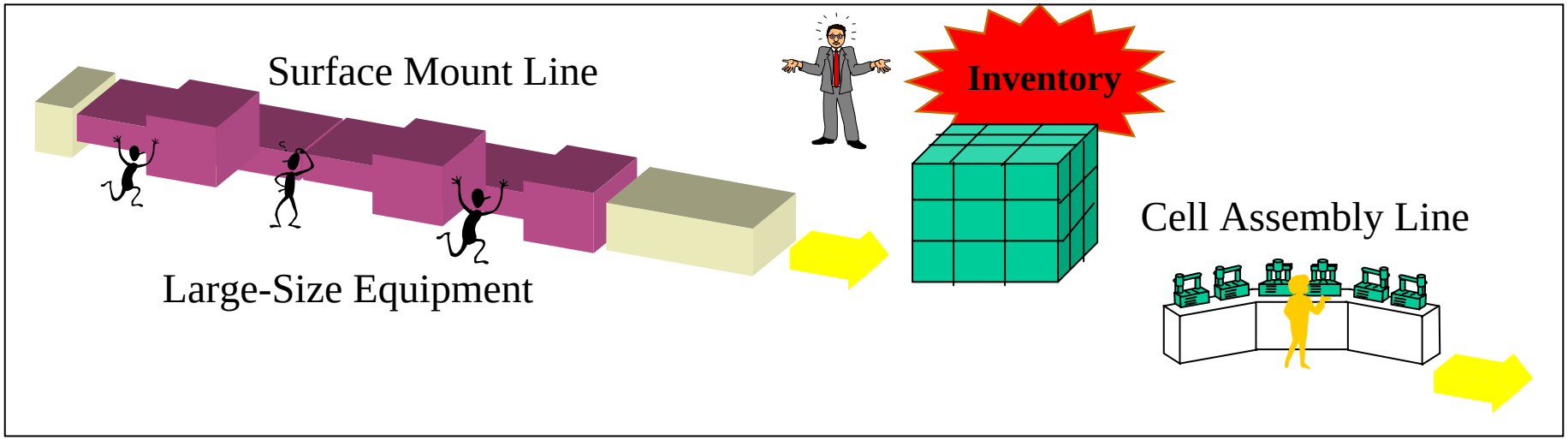
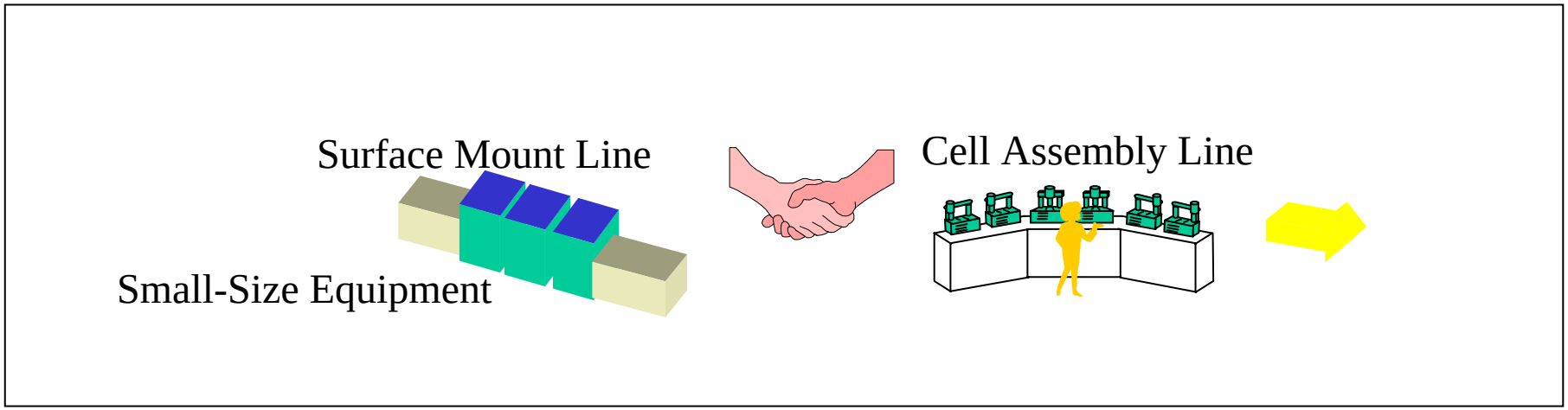
Expansion of Production Innovation Equipment





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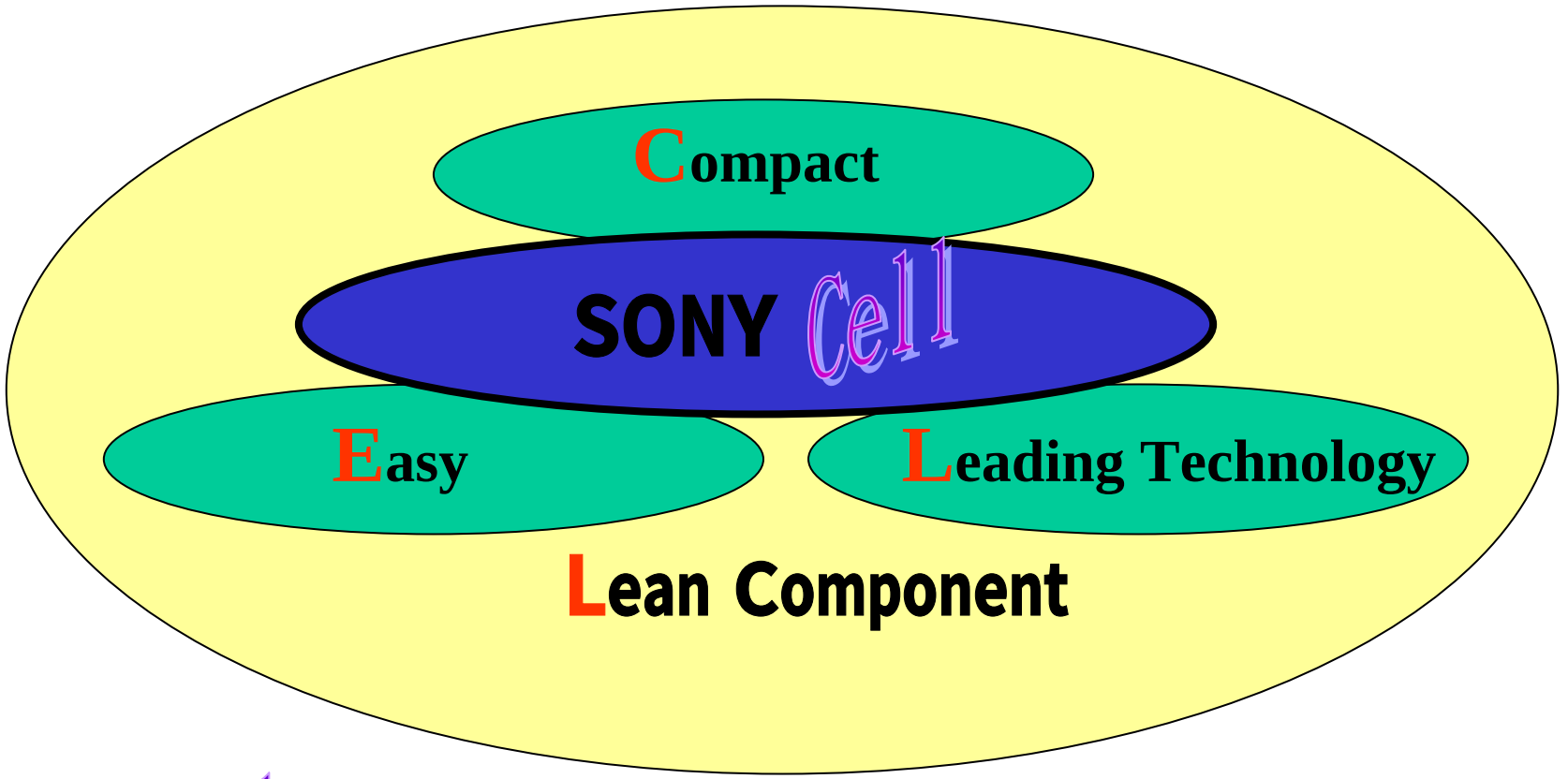
Cell Production Equipment "SONY Cell"



SONY Cell

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Summary

1. Importance of Cell Production Method
   that makes On-Demand Production Realized

2. Importance of Production Innovation Equipment
   that evolves Cell Production Method under
   Human-Equipment ‘Symbiosis’

3. Importance of Expansion of Production
   Innovation from Assembly to Front End Process

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