Human Resource Strategy

The objective of a human resource strategy is to manage labor and design jobs so people are effectively and efficiently utilized

1. ***People should be effectively utilized within the constraints of other operations management decisions***
2. ***People should have a reasonable quality of work life in an atmosphere of mutual commitment and trust***

Constraints on Human Resource Strategy

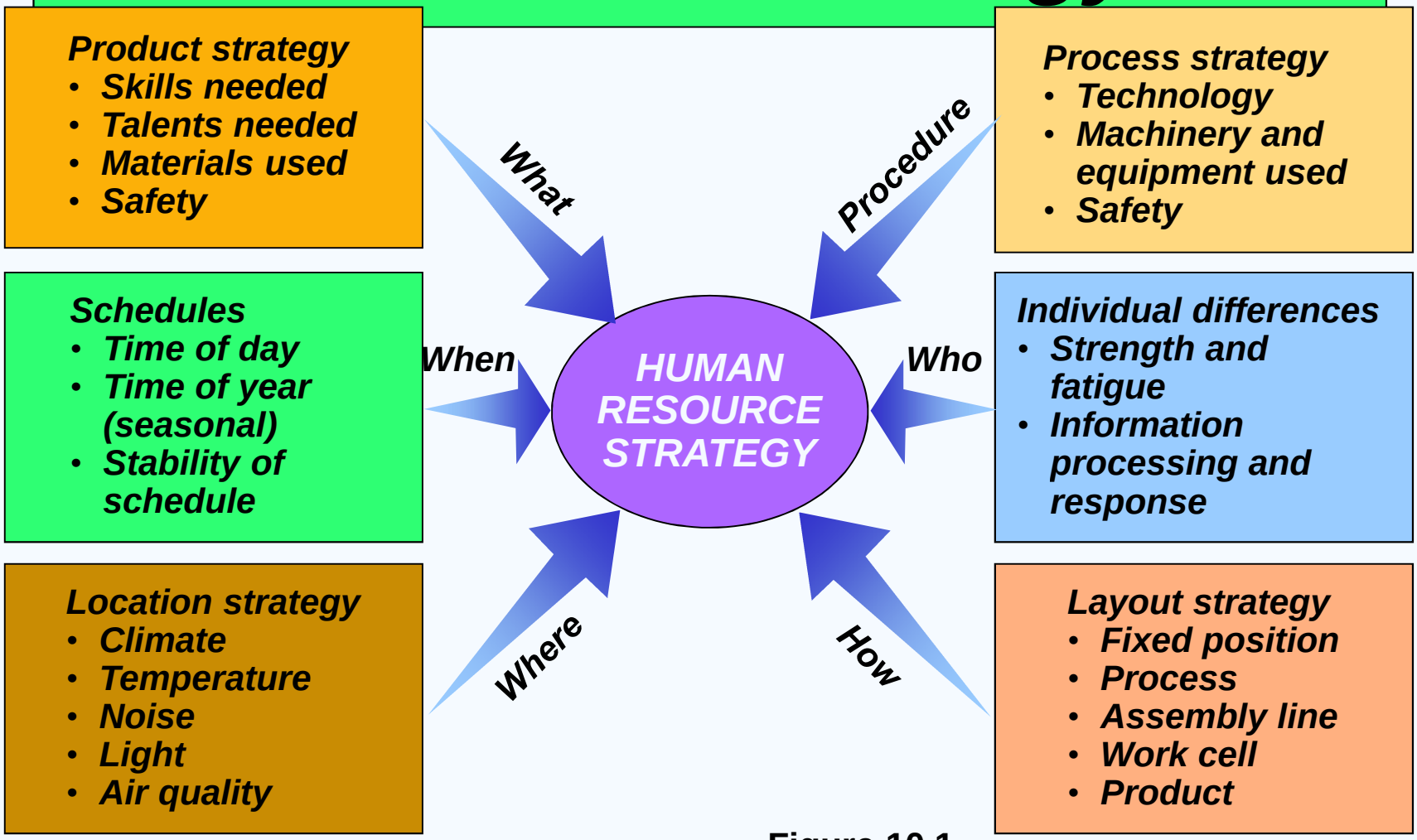


Figure 10.1

Job Design

- ☑ *Specifying the tasks that constitute a job for an individual or a group*
  1. *Job specialization*
  2. *Job expansion*
  3. *Psychological components*
  4. *Self-directed teams*
  5. *Motivation and incentive systems*
  6. *Ergonomics and work methods*
  7. *Visual workplace*

Labor Specialization

- ☑ *The division of labor into unique tasks*
- ☑ *First suggested by Adam Smith in 1776*
  1. *Development of dexterity and faster learning*
  2. *Less loss of time*
  3. *Development of specialized tools*
- ☑ *Later Charles Babbage (1832) added another consideration*
  4. *Wages exactly fit the required skill*

Job Expansion

- ☑ *Adding more variety to jobs*
- ☑ *Intended to reduce boredom associated with labor specialization*
  - ☑ *Job enlargement*
  - ☑ *Job rotation*
  - ☑ *Job enrichment*
  - ☑ *Employee empowerment*

Psychological Components of Job Design

Human resource strategy requires consideration of the psychological components of job design

Job Design Continuum

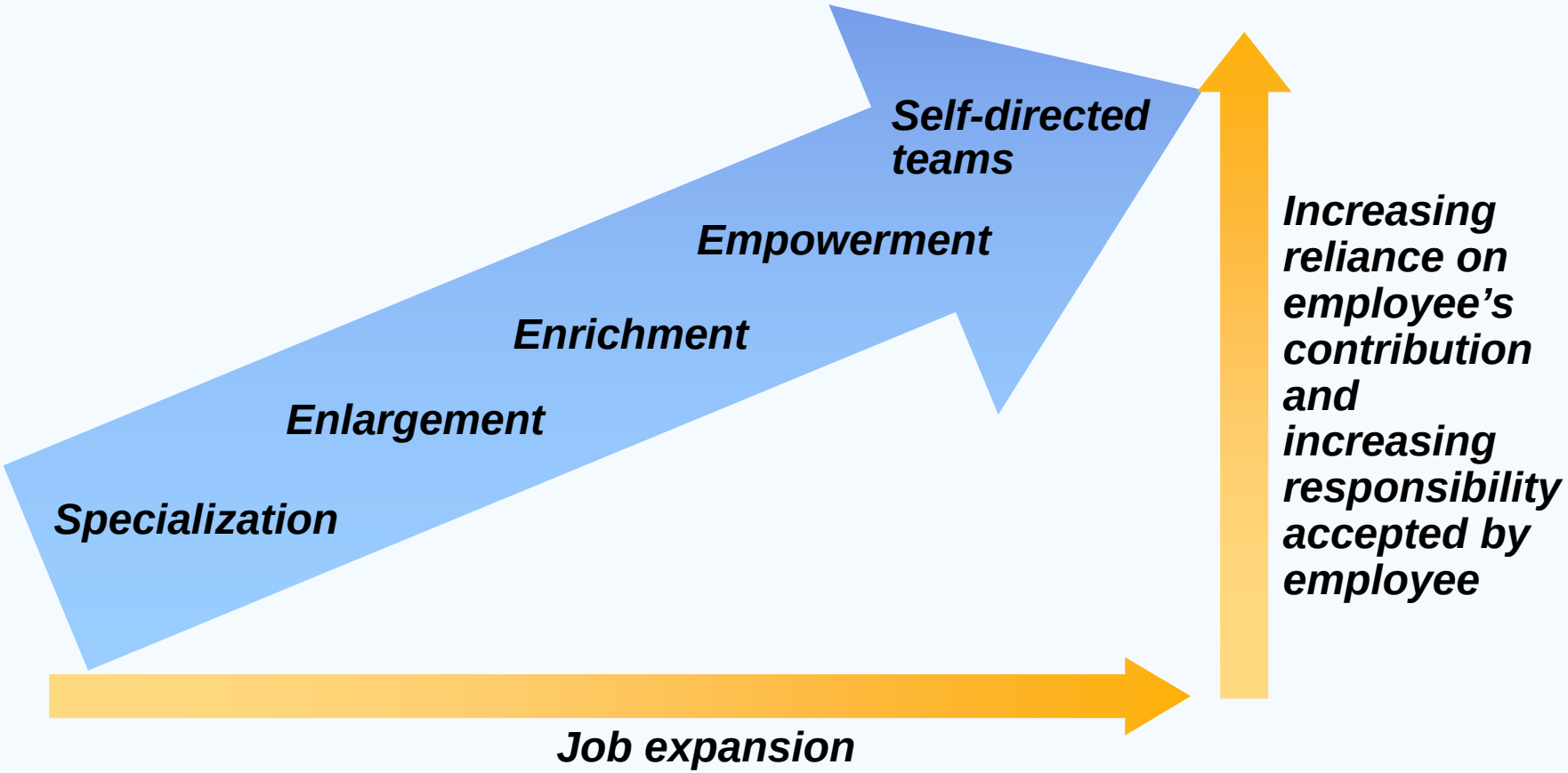


Figure 10.3

Self-Directed Teams

- ☑ *Group of empowered individuals working together to reach a common goal*
- ☑ *May be organized for long-term or short-term objectives*
- ☑ *Effective because*
  - ☑ *Provide employee empowerment*
  - ☑ *Ensure core job characteristics*
  - ☑ *Meet individual psychological needs*

Self-Directed Teams

To maximize effectiveness, managers should

- ☑ *Ensure those who have legitimate contributions are on the team*
- ☑ *Provide management support*
- ☑ *Ensure the necessary training*
- ☑ *Endorse clear objectives and goals*
- ☑ *Financial and non-financial rewards*
- ☑ *Many teams have definite life cycles*

Benefits of Teams and Expanded Job Designs

- ☑ *Improved quality of work life*
- ☑ *Improved job satisfaction*
- ☑ *Increased motivation*
- ☑ *Allows employees to accept more responsibility*
- ☑ *Improved productivity and quality*
- ☑ *Reduced turnover and absenteeism*

Limitations of Job Expansion

1. *Higher capital cost*
2. *Individuals may prefer simple jobs*
3. *Higher wages rates for greater skills*
4. *Smaller labor pool*
5. *Increased accident rates*
6. *Current technology may not lend itself to job expansion*

Motivation and Incentive Systems

- ☑ ***Bonuses - cash or stock options***
- ☑ ***Profit-sharing - profits for distribution to employees***
- ☑ ***Gain sharing - rewards for improvements***
- ☑ ***Incentive plans - typically based on production rates***
- ☑ ***Knowledge-based systems - reward for knowledge or skills***

Ergonomics and Work Methods

- ***Ergonomics is the study of the interface between man and machine***
  - ***Often called human factors***
- ***Operator input to machines***
- ***Feedback to operators***

Ergonomics and Work Methods

- ***The work environment***
  - ***Illumination/Tata cahaya***
  - ***Noise/Tata suara***
  - ***Temperature and Humidity***
  - ***Kebersihan dan kesehatan***
  - ***Keamanan dan keselamatan***
  - ***Warna***
  - ***Lay out***
  - ***Music***

Job Design and Keyboards

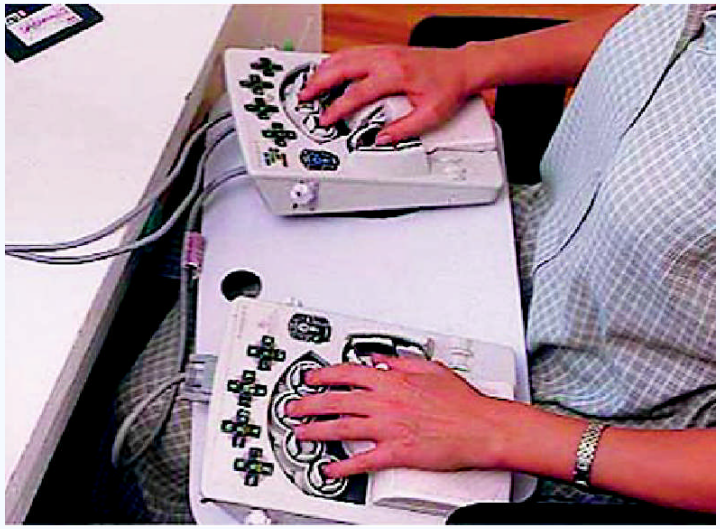


Figure 10.4

Levels of Illumination

Task Condition	Type of Task or Area	Illumination Level	Type of Illumination
Small detail, extreme accuracy	Sewing, inspecting dark materials	100	Overhead ceiling lights and desk lamp
Normal detail, prolonged periods	Reading, parts assembly, general office work	20-50	Overhead ceiling lights
Good contrast, fairly large objects	Recreational facilities	5-10	Overhead ceiling lights
Large objects	Restaurants, stairways, warehouses	2-5	Overhead ceiling lights

Table 10.2

Decibel Levels

Environment Noises	Common Noise Sources	Decibels	
	Jet takeoff (200 ft)	120	
Electric furnace area	Pneumatic hammer	100	Very annoying
Printing press plant	Subway train (20 ft)	90	
	Pneumatic drill (50 ft)	80	Ear protection required if
Inside sports car (50 mph)	Vacuum cleaner (10 ft)	70	exposed for 8
Near freeway	Speech (1 ft)		or more hours
		60	Intrusive
Private business office			
Light traffic (100 ft)	Large transformer (200 ft)	50	Quiet
		40	
Minimum levels, Chicago residential areas at night	Soft whisper (5 ft)		
Studio (speech)		30	Very quiet

Table 10.3

Methods Analysis

- ☑ *Focuses on how task is performed*
- ☑ *Used to analyze*
  1. *Movement of individuals or material*
     - ☑ *Flow diagrams*
  2. *Activities of human and machine and crew activity*
     - ☑ *Activity charts*
  3. *Body movement*
     - ☑ *Micro-motion charts*

Flow Diagram

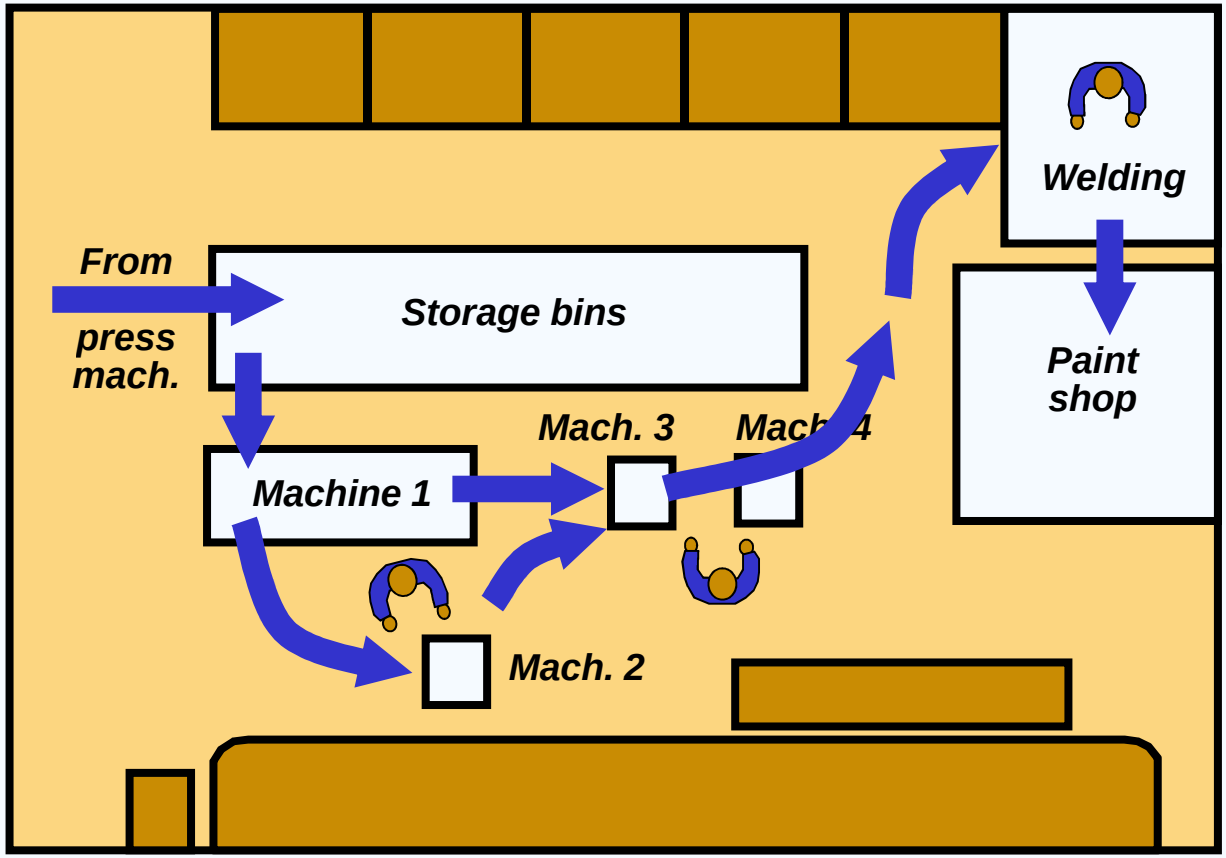


Figure 10.5 (a)

Flow Diagram

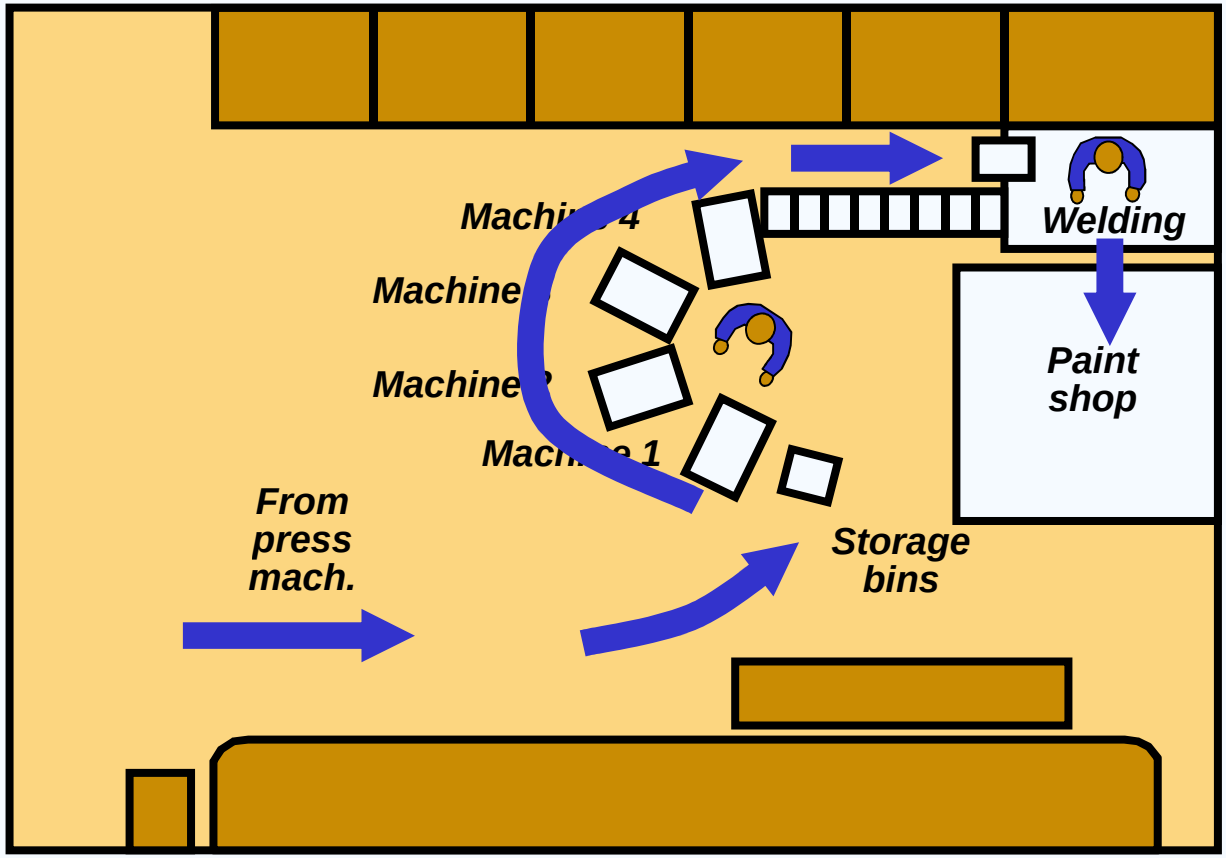


Figure 10.5 (b)

Process Chart

Present Method ☐ PROCESS CHART

Proposed Method ☒

SUBJECT CHARTED Axle-stand Production DATE 8/1/05

CHART BY JH

CHART NO. 1

DEPARTMENT Work cell for axle stand SHEET NO. 1 OF 1

DIST. IN FEET	TIME IN MINS.	CHART SYMBOLS	PROCESS DESCRIPTION
50			From press machine to storage bins at work cell
	3		Storage bins
5			Move to machine 1
	4		Operation at machine 1
4			Move to machine 2
	2.5		Operation at machine 2
4			Move to machine 3
	3.5		Operation at machine 3
4			Move to machine 4
	4		Operation at machine 4
20			Move to welding
	Poka-yoke		Poka-yoke inspection at welding
	4		Weld
10			Move to painting
	4		Paint
97	25		TOTAL

○ = operation; ⇨ = transportation; □ = inspection; D = delay; ▽ = storage

Figure 10.5 (c)

Activity Chart

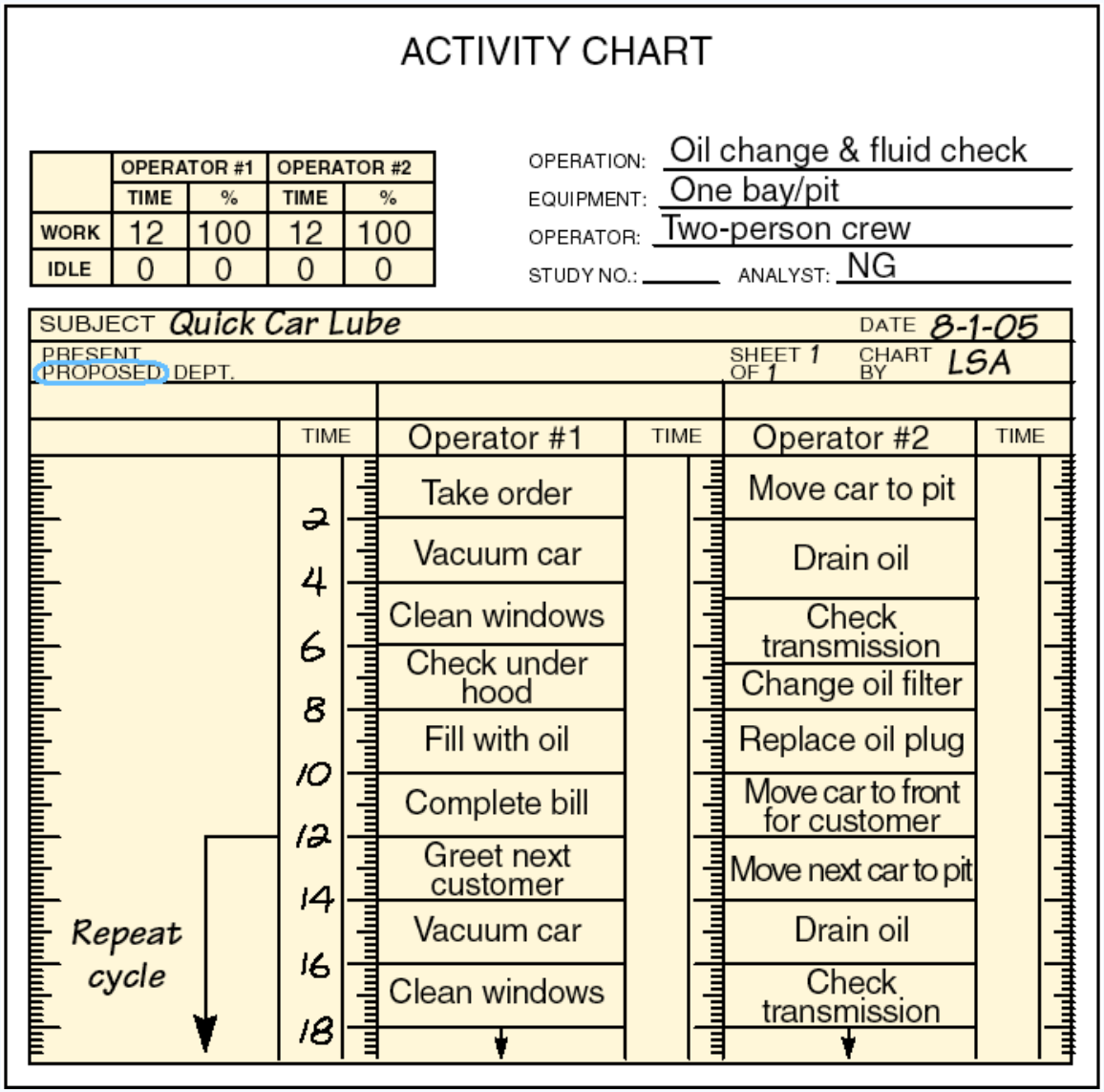


Figure 10.6

Operation Chart

OPERATION CHART

SYMBOLS	PRESENT		PROPOSED	
	LH	RH	LH	RH
○ OPERATION	2	3		
⇨ TRANSPORT.	1	1		
□ INSPECTION				
D DELAY	4	3		
▽ STORAGE				

PROCESS: Bolt–washer assembly
EQUIPMENT: _____
OPERATOR: KJH
STUDY NO: _____ ANALYST: _____
DATE: 8 / 1 / 05 SHEET NO. 1 of 1
METHOD (PRESENT / PROPOSED)
REMARKS:

LEFT-HAND ACTIVITY Present METHOD	DIST.	SYMBOLS	SYMBOLS	DIST.	RIGHT-HAND ACTIVITY Present METHOD
1 Reach for bolt		○⇨□D▽	○⇨□D▽		Idle
2 Grasp bolt		○⇨□D▽	○⇨□D▽		Idle
3 Move bolt	6″	○⇨□D▽	○⇨□D▽		Idle
4 Hold bolt		○⇨□D▽	○⇨□D▽		Reach for washer
5 Hold bolt		○⇨□D▽	○⇨□D▽		Grasp washer
6 Hold bolt		○⇨□D▽	○⇨□D▽	8″	Move washer to bolt
7 Hold bolt		○⇨□D▽	○⇨□D▽		Place washer on bolt

Figure 10.7

The Visual Workplace

- ☑ *Use low-cost visual devices to share information quickly and accurately*
- ☑ *Displays and graphs replace printouts and paperwork*
- ☑ *Able to provide timely information in a dynamic environment*
- ☑ *System should focus on improvement*

The Visual Workplace

Visual signals can take many forms and serve many functions

- ☑ ***Present the big picture***
- ☑ ***Performance***
- ☑ ***Housekeeping***

Ethics and the Work Environment

1. Keadilan dan etika merupakan kendala penting dari desain pekerjaan
2. Isu-isu penting mungkin berhubungan dengan kesempatan yang sama, upah yang sama untuk pekerjaan yang sama, dan kondisi kerja yang aman
3. Membantu untuk bekerja sama dengan instansi pemerintah, serikat buruh, asuransi,dan karyawan

Labor Standards

1. Perencanaan tenaga kerja yang efektif bergantung pada pengetahuan tentang tenaga kerja yang dibutuhkan
2. Standar Tenaga kerja adalah jumlah waktu yang diperlukan untuk melakukan pekerjaan atau bagian dari pekerjaan
3. Standar perburuhan Akurat membantu menent ukan kebutuhan tenaga kerja, biaya,dan kerja yang adil

Labor Standards and Work Measurement

1. Dimulai pada awal abad ke-20
2. Penting untuk kedua organisasi manufaktur dan jasa
3. Diperlukan untuk menentukan kebutuhan staf
4. Penting untuk sistem insentif kerja

Meaningful Standards Help Determine

1. Ketenagakerjaan item yang diproduksi
2. Kebutuhan staf
3. Biaya dan perkiraan waktu
4. ukuran kru dan menyeimbangkan kerja
5. perencanaan produksi
6. rencana insentif upah Dasar
7. Efisiensi karyawan

Labor Standards

May be set in four ways:

1. ***Historical experience***
2. ***Time studies***
3. ***Predetermined time standards***
4. ***Work sampling***

Work Sampling Time Studies

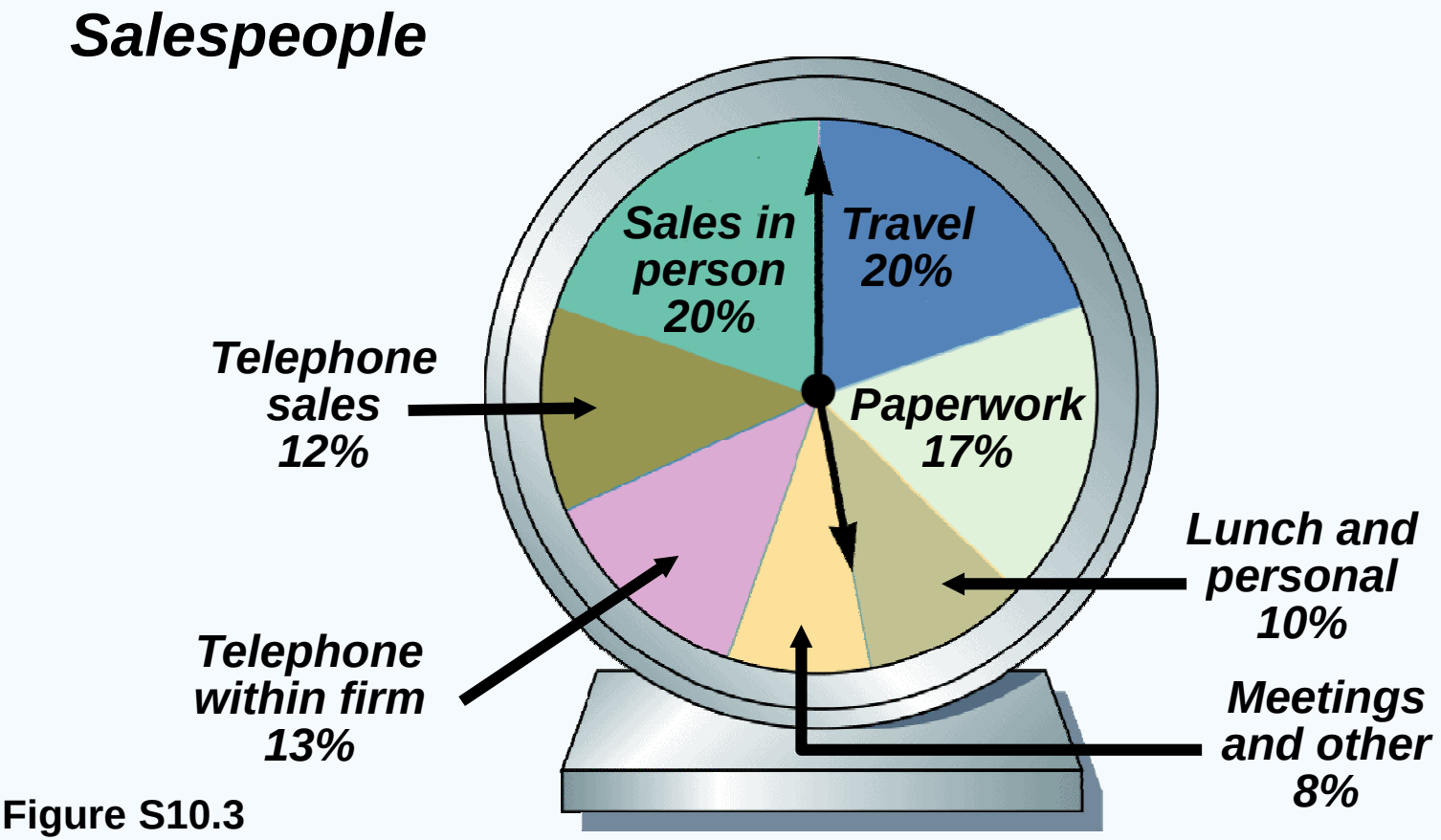


Figure S10.3

Work Sampling Time Studies

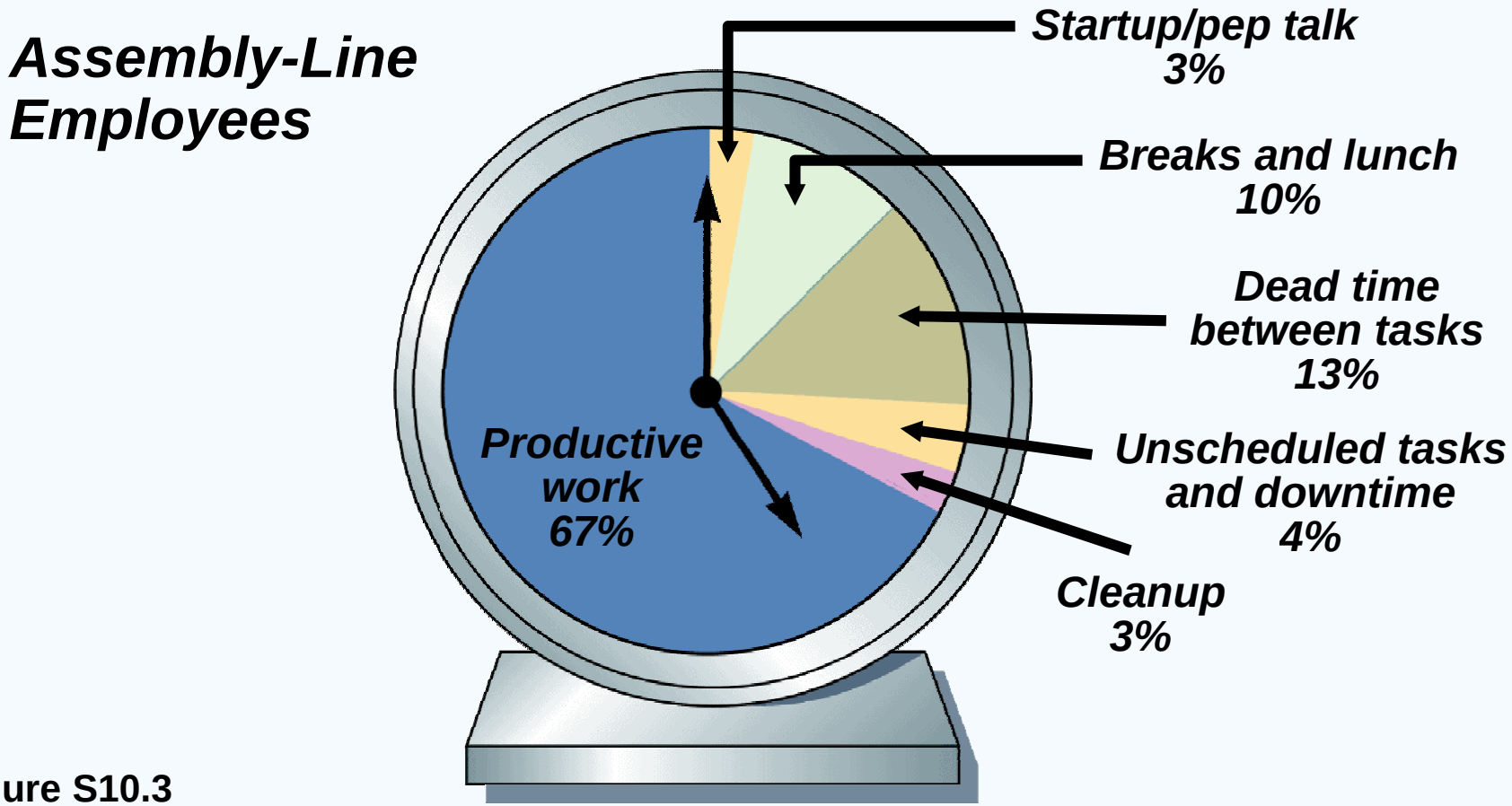


Figure S10.3

Diskusi

Penetapan UMK

KOMPONEN KEBUTUHAN HIDUP LAYAK UNTUK PEKERJA LAJANG
DALAM SEBULAN DENGAN 3.000 K KALORI PER HARI

NO	KOMPONEN DAN JENIS KEBUTUHAN	KUALITAS/ KRITERIA	JUMLAH KEBUTUHAN	SATUAN	HARGA SATUAN (Rp)	NILAI SEBULAN (Rp)
I.	MAKANAN DAN MINUMAN					
1	Beras	Sedang	10.00	Kg		
2	Sumber Protein :					
	a. Daging	Sedang	0.75	Kg		
	b. Ikan Segar	Baik	1.20	Kg		
	c. Telur ayam	Telur ayam ras	1.00	Kg		
3	Kacang-kacangan :					
	Tempe/tahu	Baik	4.50	Kg		
4	Susu bubuk	Sedang	0.90	Kg		
5	Gula pasir	Sedang	3.00	Kg		
6	Minyak goreng	Curah	2.00	Kg		
7	Sayuran	Baik	7.20	Kg		
8	Buah-buahan (setara pisang/pepaya)	Baik	7.50	Kg		
9	Karbohidrat lain (setara tepung terigu)	sedang	3.00	Kg		
10	Teh atau	Celup	1.00	Dus isi 25		
	kopi	Sachet	4.00	75 gr		
11	Bumbu-bumbuan	(nilai 1 s/d 10)	15.00	%		
	JUMLAH					
II.	SANDANG					
12	Celana panjang/rok/Pakaian Muslim	katun Sedang	6/12	Potong		
13	Celana pendek	katun sedang	2/12	potong		
14	Ikat Pinggang	Kulit sintetis, Polos, Tidak Branded	1/12	Buah		
15	Kemeja lengan pendek/blus	setara katun	6/12	Potong		
16	Kaos oblong /BH	Sedang	6/12	Potong		
17	Celana dalam	Sedang	6/12	Potong		
18	Sarung/kain panjang	Sedang	3/24	Helai		
19	Sepatu	kulit sintetis	2/12	Pasang		
20	Kaos Kaki	Katun,Polyester, Polos, Sedang	4/12	Pasang		
21	Perlengkapan pembersih sepatu :					
	a. Semir Sepatu	Sedang	6/12	Buah		
	b. Sikat Sepatu	Sedang	1/12	Buah		
22	Sandal jepit	karet	2/12	Pasang		
23	Handuk mandi	100 cm x 60 cm	1/12	Potong		
24	Perlengkapan Ibadah :					
	a. Sajadah	sedang	1/12	Potong		
	b. Mukenah	sedang	1/12	Potong		
	c. Peci, dll	sedang	1/12	Potong		
	JUMLAH					

III.	PERUMAHAN					
25	Sewa kamar	dapat menampung jenis KHL lainnya	1.00	Bulan		
26	Dipan/tempat tidur	No.3, polos	1/48	Buah		
27	Perlengkapan tidur :					
	a. Kasur Busa	busa	1/48	Buah		
	b. Bantal Busa	busa	2/36	Buah		
28	Seprei dan sarung bantal	katun	2/12	Set		
29	Meja dan kursi	1 meja/4 kursi	1/48	Set		
30	Lemari pakaian	Kayu Sedang	1/48	Buah		
31	Sapu	Ijuk Sedang	2/12	Buah		
32	Perlengkapan makan :					
	a. Piring makan	polos	3/12	Buah		
	b. Gelas minum	polos	3/12	Buah		
	c. Sendok dan garpu	Sedang	3/12	Pasang		
33	Ceret almunium	ukuran 25cm	1/24	Buah		
34	Wajan almunium	ukuran 32cm	1/24	Buah		
35	Panci almunium	ukuran 32cm	2/12	Buah		
36	Sendok masak	almunium	1/12	Buah		
37	Rice Cooker ukuran 1/2 liter	350 watt	1/48	Buah		
38	Kompor dan Perlengkapannya :					
	a. Kompor Gas 1 tungku	SNI	1/24	Buah		
	b. Selang dan regulator	SNI	1/24	Set		
	c. Tabung Gas 3 kg	Pertamina	1/60	Buah		
39	Gas Elpiji	@ 3 kg	2.00	tabung		
40	Ember plastik	isi 20 liter	2/12	Buah		
41	Gayung Plastik	sedang	1/12	Buah		
42	Listrik	900 watt	1.00	Bulan		
43	Bola Lampu hemat energi	14 watt	3/12	Buah		
44	Air bersih	standar PAM	2.00	Meter Kubik		
45	Sabun cuci pakaian	cream/ deterjen	1.50	Kg		
46	Sabun cuci piring (colek)	500 gr	1.00	buah		
47	Seterika	250 Watt	1/48	buah		
48	Rak Piring Portable plastik	Sedang	1/24	buah		
49	Pisau dapur	Sedang	1/36	buah		
50	Cermin	30 x 50 cm	1/36	Buah		
	JUMLAH					

IV.	PENDIDIKAN					
51	Bacaan/	Tabloid/	4 atau	Eks atau		
	radio	4 band	1/48	buah		
52	Ballpoint/pensil	Sedang	6/12	buah		
	JUMLAH					
V.	KESEHATAN					
53	Sarana kesehatan :					
	a. Pasta gigi	80 gram	1.00	Tube		
	b. Sabun mandi	80 gram	2.00	Buah		
	c. Sikat gigi	produk lokal	3/12	Buah		
	d. Shampoo	produk lokal	1.00	Botol 100 ml		
	e. Pembalut atau	isi 10	1.00	Dus		
	alat cukur		1.00	set		
54	Deodorant	100 ml/g	6/12	Botol		
55	Obat anti nyamuk	Bakar	3.00	Dus		
56	Potong rambut	ditukang cukur/salon	6/12	Kali		
57	Sisir	biasa	2/12	Buah		
	JUMLAH					
VI.	TRANSPORTASI					
58	Transport kerja dan lainnya	Angkutan Umum	30	Hari (PP)		
	JUMLAH					
VII.	REKREASI DAN TABUNGAN					
59	Rekreasi	daerah sekitar	2/12	Kali		
60	Tabungan (2% dari nilai 1 s.d 59)		2	%		
	JUMLAH					
	JUMLAH (I + II + III + IV + V + VI + VII)					

Copas #1 : *“Di sektor **sandang** ada penambahan 10 komponen yang ditetapkan buruh sebagai komponen kelayakan. Penambahan tersebut antara lain **kepemilikan jaket kulit sintetis (satu potong per tahun), baju tidur setara katun (enam potong per tahun), sandal semidinas kulit (dua pasang per tahun), tas kerja ukuran sedang (satu buah per tahun), sapu tangan (enam buah per tahun), dompet kulit (satu buah per tahun), jam tangan, jam dinding, payung, dan topi (masing-masing satu unit per tahun).**”*

Copas #2 : *"Di sektor **perumahan** ada penambahan 12 item. Antara lain **dispenser (satu unit per tiga tahun), mesin cuci (satu unit per tiga tahun), sapu lidi dan sapu ijuk (dua unit per tahun), talenan plastik (satu unit per dua tahun), tikar (dua unit per dua tahun) dan gunting stainless (satu unit per tahun)**."*

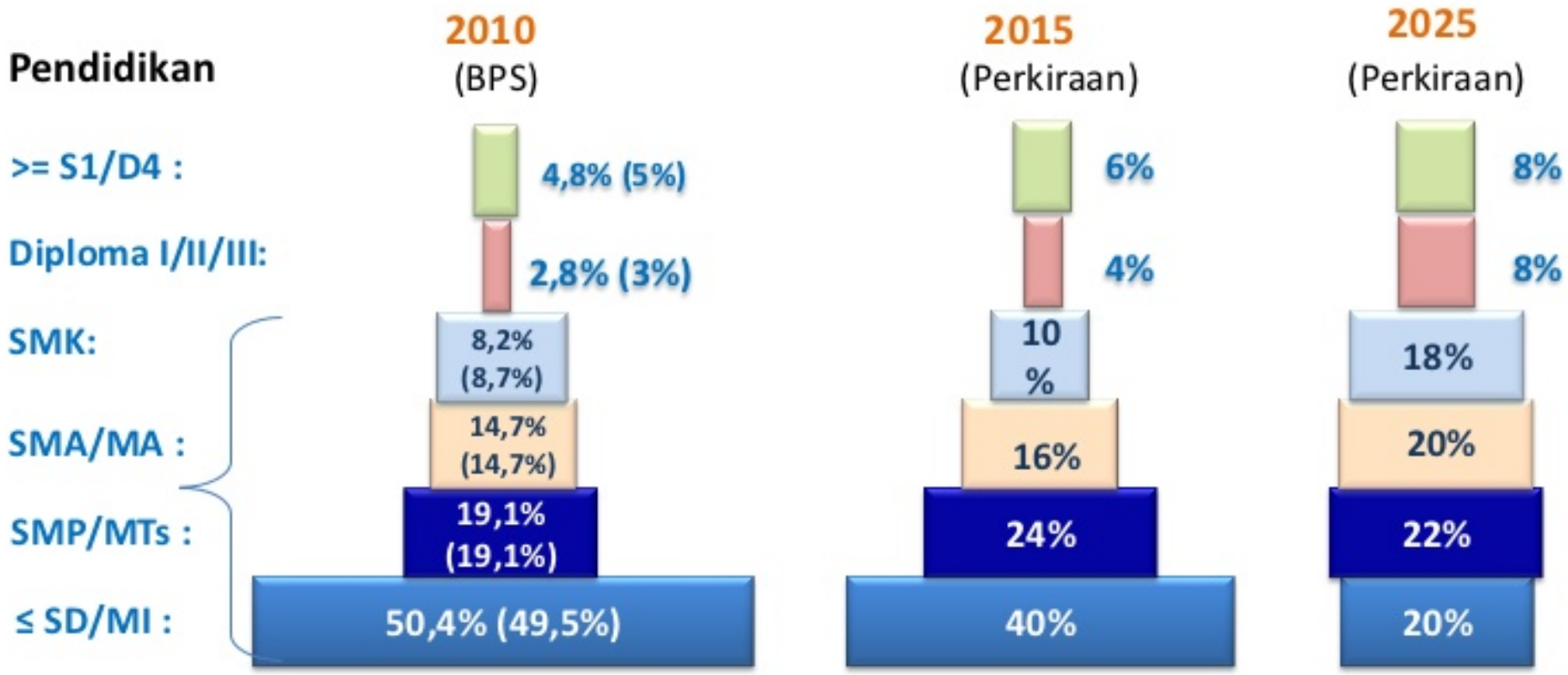
Copas #3 : "*Di sektor **pendidikan** ada penambahan satu komponen, yakni **televisi minimal ukuran 19 inci (satu unit per tiga tahun)**."*

Copas #4 : *"Di sektor **kesehatan** ada pengurangan komponen. Semula ada**komponen sisir dan deodorant biasa** minimal satu unit per tahun. Namun, komponen itu **kini dimampatkan pada sarana kesehatan, bersama penambahan subkomponen lain seperti gunting kuku, cotton bud, parfum, lipstik, hand and body lotion dan pembersih muka. Dua komponen itu diganti dengan satu komponen suplemen kesehatan.**"*

Copas #5 : *"Di sektor **transportasi dan kemasyarakatan** ada penambahan dua komponen, yakni **handphone minimal satu unit beserta pulsa** yang belum ditentukan besarannya. Selain itu, ada **penambahan komponen kegiatan kemasyarakatan mencakup iuran keamanan, iuran sampah, dana sosial, dan iuran RT yang perlu dibayarkan tiap tahun.**"*

Copas #6 : *"Terakhir, di sektor **rekreasi dan tabungan** tak ada penambahan komponen. Namun, **besaran untuk komponen tabungan naik dari dua persen tahun lalu menjadi tiga persen tahun ini, dihitung dari total 84 komponen yang diajukan buruh** sebagai komponen hidup layak 2014."*

Tingkat Pendidikan Tenaga Kerja Indonesia



Catatan: (..) tahun 2011

Analisis Posisi Daya Saing Negara-negara ASEAN Memasuki AFTA Tahun 2015

No	Indikator Kinerja	Ranking Posisi Daya Saing Negara-Negara ASEAN (1 = Terbaik/Tertinggi - 10 = Terburuk/Terendah)									
		Singapura	Brunei	Thailand	Malaysia	Vietnam	Filipina	Kamboja	Indonesia	Laos	Myanmar
1	Indeks Daya Saing Global, 2013-2014	1	3	4	2	7	6	9	5	8	10
2	Indeks Kinerja Logistik, 2014	1	n.a	3	2	4	6	7	5	8	9
3	Indeks Inovasi Global, 2013	1	4	3	2	5	7	8	6	n.a	n.a
4	Indeks Kemudahan Bisnis, 2014	1	4	3	2	5	6	8	7	9	10
5	Indeks *Worldwide Governance Indicator Ave*., 2012	1	2	4	3	5	6	8	7	10	9
6	Indeks Persepsi Korupsi, 2012	1	2	5	3	7	4	10	6	8	9
7	*Corporate Tax*, 2014	1	5	2	8	5	10	2	8	7	2
8	Produktivitas Tenaga Kerja, 2012	2	1	4	3	7	6	9	5	8	10
9	Suku Bunga (*Interest Rate*), 2014	1	7	3	4	8	5	2	9	6	10
10	Upah Minimum Tenaga Kerja	9	n.a	5	8	4	6	1	7	2	3
	Skor Total 10 Indikator Pilihan VG =	19	28	36	37	57	62	64	65	66	72
	Skor Rata-rata 10 Indikator Pilihan VG =	1,9	3,5	3,6	3,7	5,7	6,2	6,4	6,5	7,3	8,0
	RANKING POSISI DAYA SAING Versi VG =	1	2	3	4	5	6	7	8	9	10

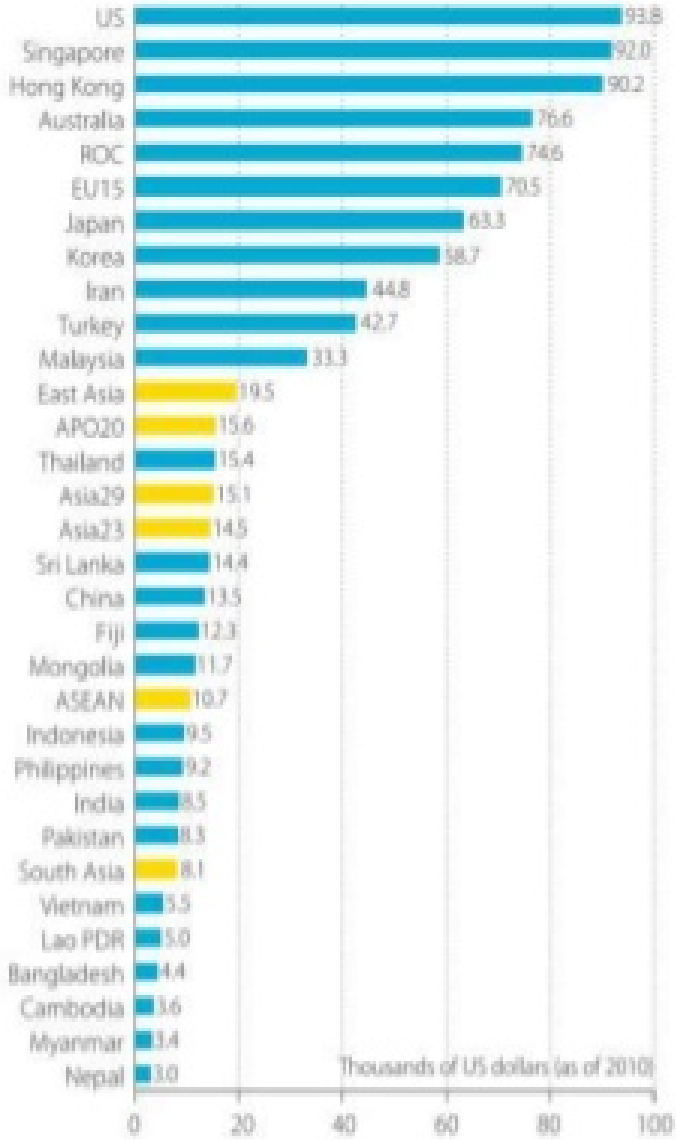
Sumber: Vincent Gaspersz, 2014 (Dok.Pribadi) Diolah dari Berbagai Laporan (Sumber).

Produktivitas Tenaga Kerja di Indonesia

Labor Productivity Level by Per Worker GDP

Basis data 2011, tingkat produktivitas tenaga kerja berdasarkan PDB per pekerja, untuk negara ASEAN berurutan sebagai berikut:

1. Brunai Darussalam (USD 92,3 ribu)
2. Singapura (USD 92,0 ribu)
3. Malaysia (USD 33,3 ribu)
4. Thailand (USD 15,4 ribu)
5. **Indonesia (USD 9,5 ribu)**
6. Pilipina (USD 9,2 ribu)
7. Vietnam (USD 5,5 ribu)
8. Laos (USD 5,0 ribu)
9. Kamboja (USD 3,6 ribu)
10. Burma (USD 3,4 ribu)



Source: APO Productivity Databook 2013

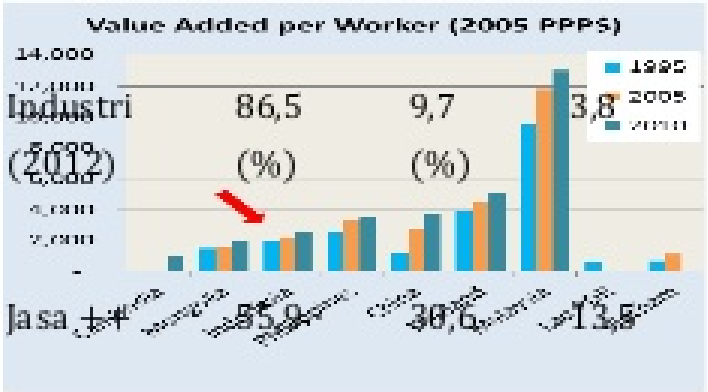
KUALITAS PEKERJA DAN PRODUKTIVITAS

- Hanya 5 persen dari pekerja yang memperoleh pelatihan, menyebabkan sebagian besar tenaga kerja memiliki keahlian rendah. Pelambatan keterampilan pekerja, menyebabkan produktivitas tenaga kerja secara keseluruhan rendah, termasuk dibandingkan negara-negara di ASEAN.

PENGANGGURAN TERBUKA **MENURUT PELATIHAN YANG PERNAH DITERIMA, AGUSTUS 2010**

Pernah Memperoleh Pelatihan
5%

110,8 Juta	Low	Semi-	Skilled	Total
Pertanian	96,3	3,6	0,1	100,0
Pekerja	skilled	Skilled	(%)	(%)
Industri	86,5	9,7	3,8	100,0
(2012)	(%)	(%)		
Jasa	55,9	30,6	13,5	100,0



Instruksi Presiden (Inpres) No. 9/2013 yang mengatur penetapan UMK berdasarkan produktifitas pekerja/buruh

Equal pay for equal work, equal pay for equal performance

The Strategic Importance of the Supply Chain

Supply-chain management is the integration of the activities that procure materials and services, transform them into intermediate goods and the final product, and deliver them to customers

Competition is no longer between companies; it is between supply chains

What Supply Chain Management does for a company

1. *Improves operations*
2. *Increases levels of outsourcing*
3. *Decreases transportation costs*
4. *Reduces Competitive pressures*
5. *Increases globalization*
6. *Increases importance of e-commerce*
7. *Reduces the Complexity of supply chains*
8. *Helps Manage and minimize inventories*

•Benefits of Supply Chain Management

- *Lower inventories*
- *Higher productivity*
- *Shorter lead times*
- *Higher profits*
- *Greater customer loyalty*

A Supply Chain

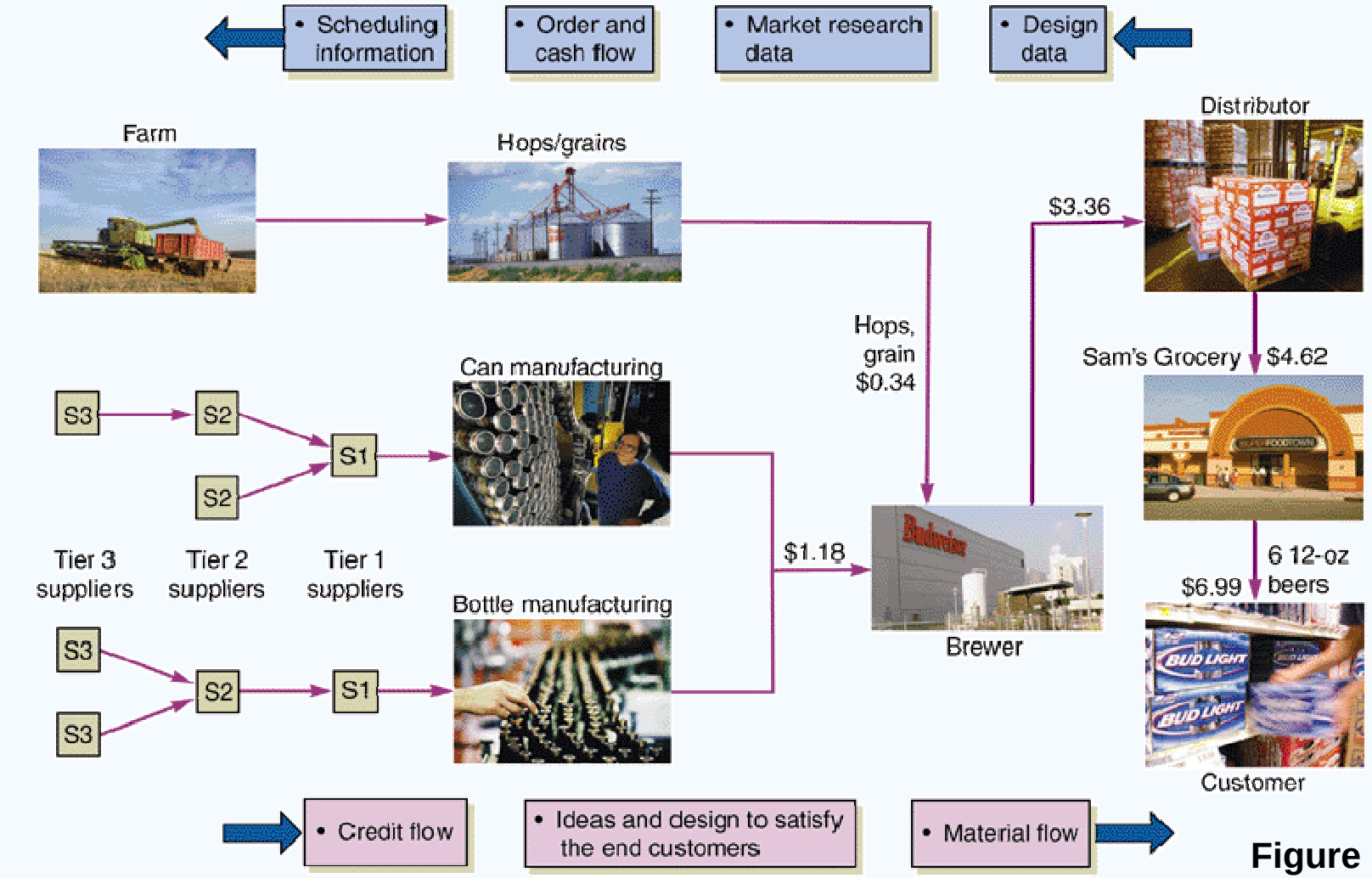


Figure 11.1

Make-or-Buy Decisions

Reasons for Making
1. Maintain core competence
2. Lower production cost
3. Unsuitable suppliers
4. Assure adequate supply (quantity or delivery)
5. Utilize surplus labor or facilities
6. Obtain desired quality
7. Remove supplier collusion
8. Obtain unique item that would entail a prohibitive commitment for a supplier
9. Protect personnel from a layoff
10. Protect proprietary design or quality
11. Increase or maintain size of company

Table 11.4

Make-or-Buy Decisions

Reasons for Buying
1. Frees management to deal with its primary business
2. Lower acquisition cost
3. Preserve supplier commitment
4. Obtain technical or management ability
5. Inadequate capacity
6. Reduce inventory costs
7. Ensure alternative sources
8. Inadequate managerial or technical resources
9. Reciprocity
10. Item is protected by a patent or trade secret

Table 11.4

Outsourcing

- ☑ *Transfers traditional internal activities and resources of a firm to outside vendors*
- ☑ *Utilizes the efficiency that comes with specialization*
- ☑ *Firms outsource information technology, accounting, legal, logistics, and production*

Supply-Chain Strategies

- ☑ *Negotiating with many suppliers*
- ☑ *Long-term partnering with few suppliers*
- ☑ *Vertical integration*
- ☑ *Keiretsu*
- ☑ *Virtual companies that use suppliers on an as needed basis*

Many Suppliers

- ☑ ***Commonly used for commodity products***
- ☑ ***Purchasing is typically based on price***
- ☑ ***Suppliers are pitted against one another***
- ☑ ***Supplier is responsible for technology, expertise, forecasting, cost, quality, and delivery***

Few Suppliers

- ☑ ***Buyer forms longer term relationships with fewer suppliers***
- ☑ ***Create value through economies of scale and learning curve improvements***
- ☑ ***Suppliers more willing to participate in JIT programs and contribute design and technological expertise***
- ☑ ***Cost of changing suppliers is huge***

Vertical Integration

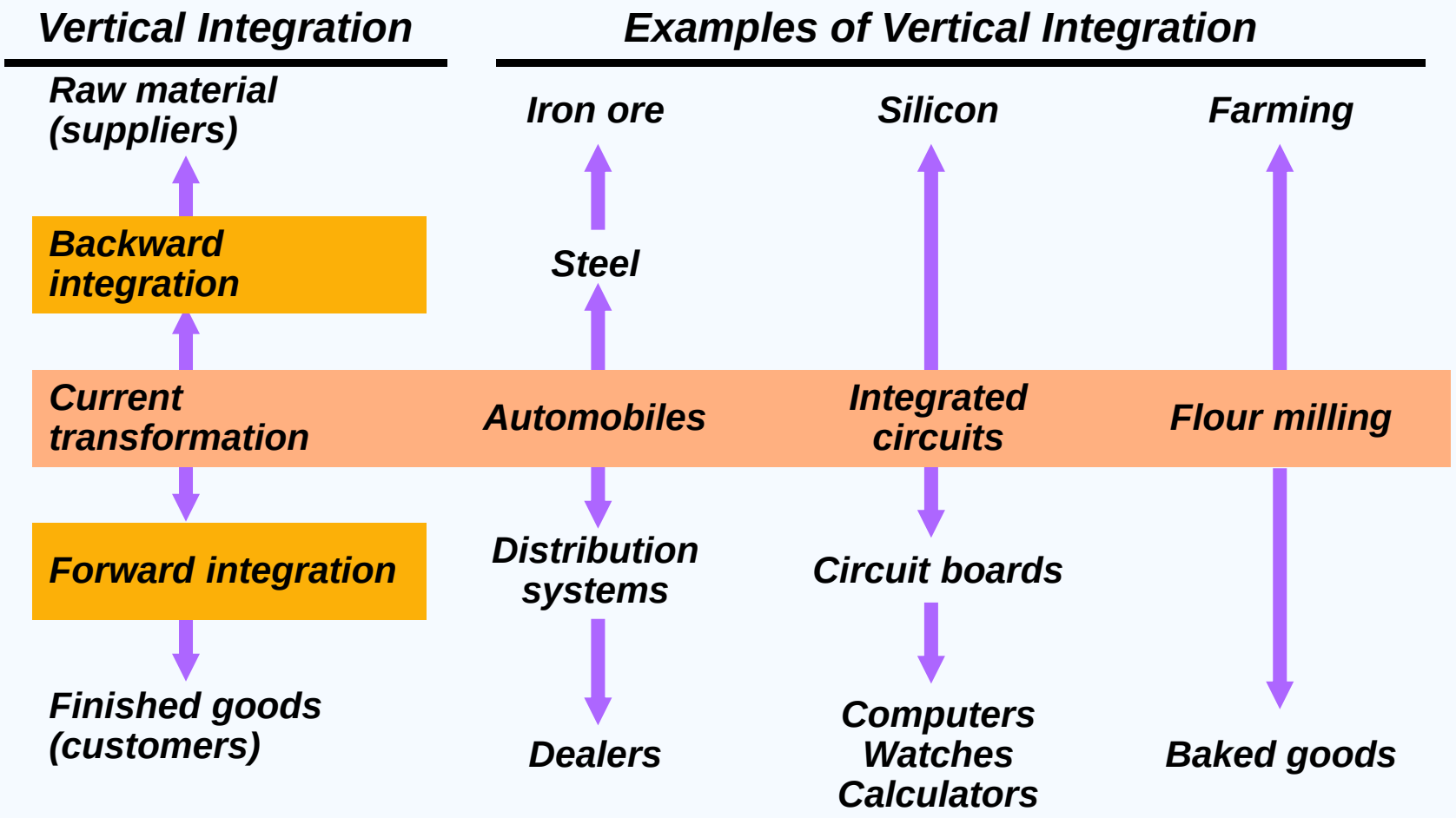


Figure 11.2

Vertical Integration

- ☑ *Developing the ability to produce goods or service previously purchased*
- ☑ *Integration may be forward, towards the customer, or backward, towards suppliers*
- ☑ *Can improve cost, quality, and inventory but requires capital, managerial skills, and demand*
- ☑ *Risky in industries with rapid technological change*

Vendor Selection

- ☑ **Negotiations**
  - ☑ **Cost-Based Price Model - supplier opens books to purchaser**
  - ☑ **Market-Based Price Model - price based on published, auction, or indexed price**
  - ☑ **Competitive Bidding - used for infrequent purchases but may make establishing long-term relationships difficult**

Vendor Evaluation

Criteria	Weights	Scores (1-5)	Weight x Score
Engineering/research/innovation skills	.20	5	1.0
Production process capability (flexibility/technical assistance)	.15	4	.6
Distribution/delivery capability	.05	4	.2
Quality systems and performance	.10	2	.2
Facilities/location	.05	2	.1
Financial and managerial strength (stability and cost structure)	.15	4	.6
Information systems capability (e-commerce, Internet)	.10	2	.2
Integrity (environmental compliance/ ethics)	.20	5	1.0
Total	1.00		3.9

The Spirit of Partnership

- ***Have a common goal***
- ***Mutual benefit***
- ***Mutual trust***
- ***Transparent***
- ***Long term relationship***
- ***Continuous improvement in quality and cost***

Operations Management

Chapter 14 – Material Requirements Planning (MRP) and ERP

PowerPoint presentation to accompany
Heizer/Render
Principles of Operations Management, 7e
Operations Management, 9e

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Benefits of MRP

1. Better response to customer orders
2. Faster response to market changes
3. Improved utilization of facilities and labor
4. Reduced inventory levels

Dependent Demand

- ☑ *The demand for one item is related to the demand for another item*
- ☑ *Given a quantity for the end item, the demand for all parts and components can be calculated*
- ☑ *In general, used whenever a schedule can be established for an item*
- ☑ *MRP is the common technique*

Dependent Demand

Effective use of dependent demand inventory models requires the following

1. ***Master production schedule***
2. ***Specifications or bill of material***
3. ***Inventory availability***
4. ***Purchase orders outstanding***
5. ***Lead times***

Master Production Schedule (MPS)

- ☑ ***Specifies what is to be made and when***
- ☑ ***Must be in accordance with the aggregate production plan***
- ☑ ***Inputs from financial plans, customer demand, engineering, supplier performance***
- ☑ ***As the process moves from planning to execution, each step must be tested for feasibility***
- ☑ ***The MPS is the result of the production planning process***

Master Production Schedule (MPS)

- ☑ *MPS is established in terms of specific products*
- ☑ *Schedule must be followed for a reasonable length of time*
- ☑ *The MPS is quite often fixed or frozen in the near term part of the plan*
- ☑ *The MPS is a rolling schedule*
- ☑ *The MPS is a statement of what is to be produced, not a forecast of demand*

The Planning Process

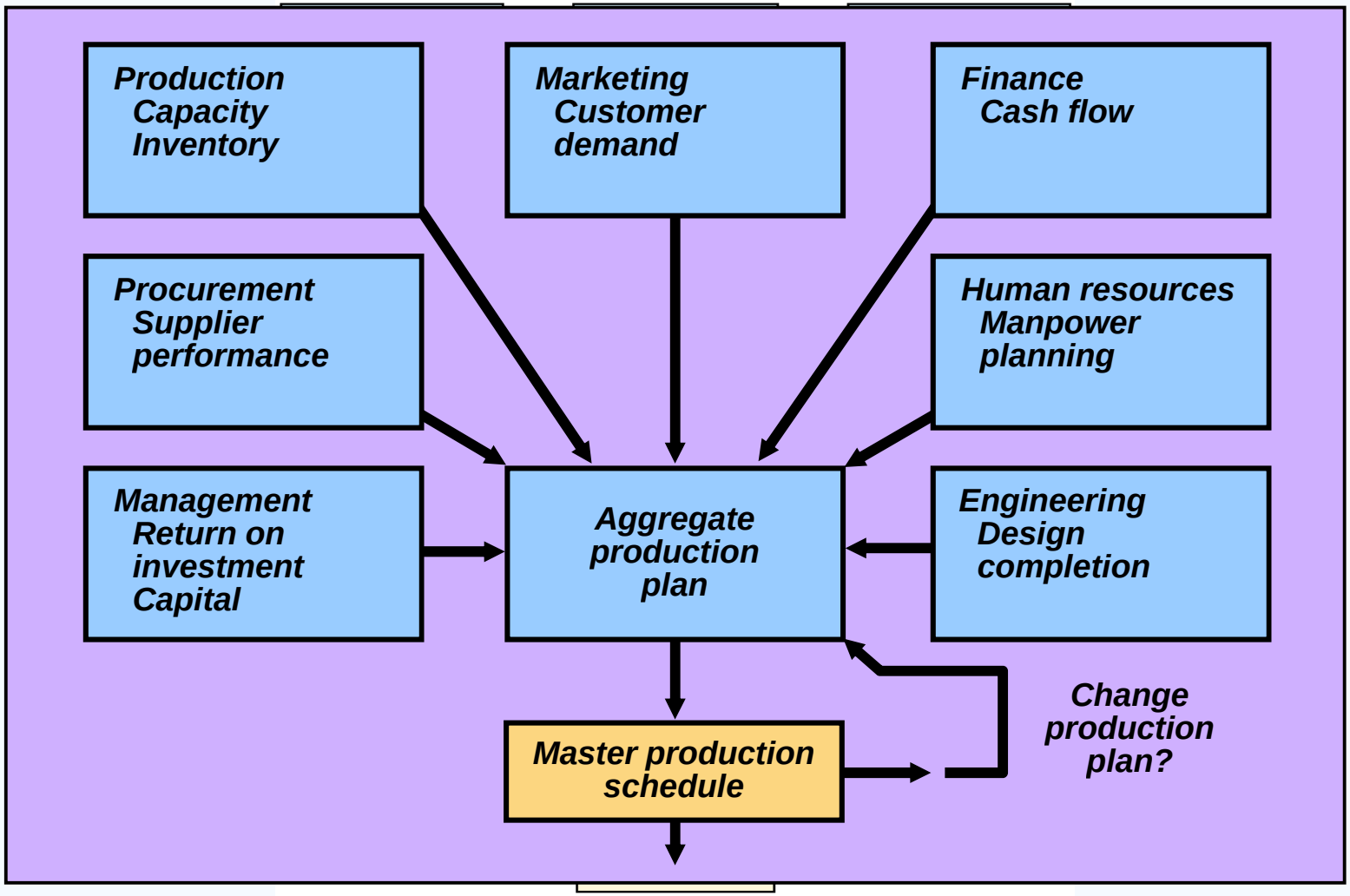


Figure 14.1

The Planning Process

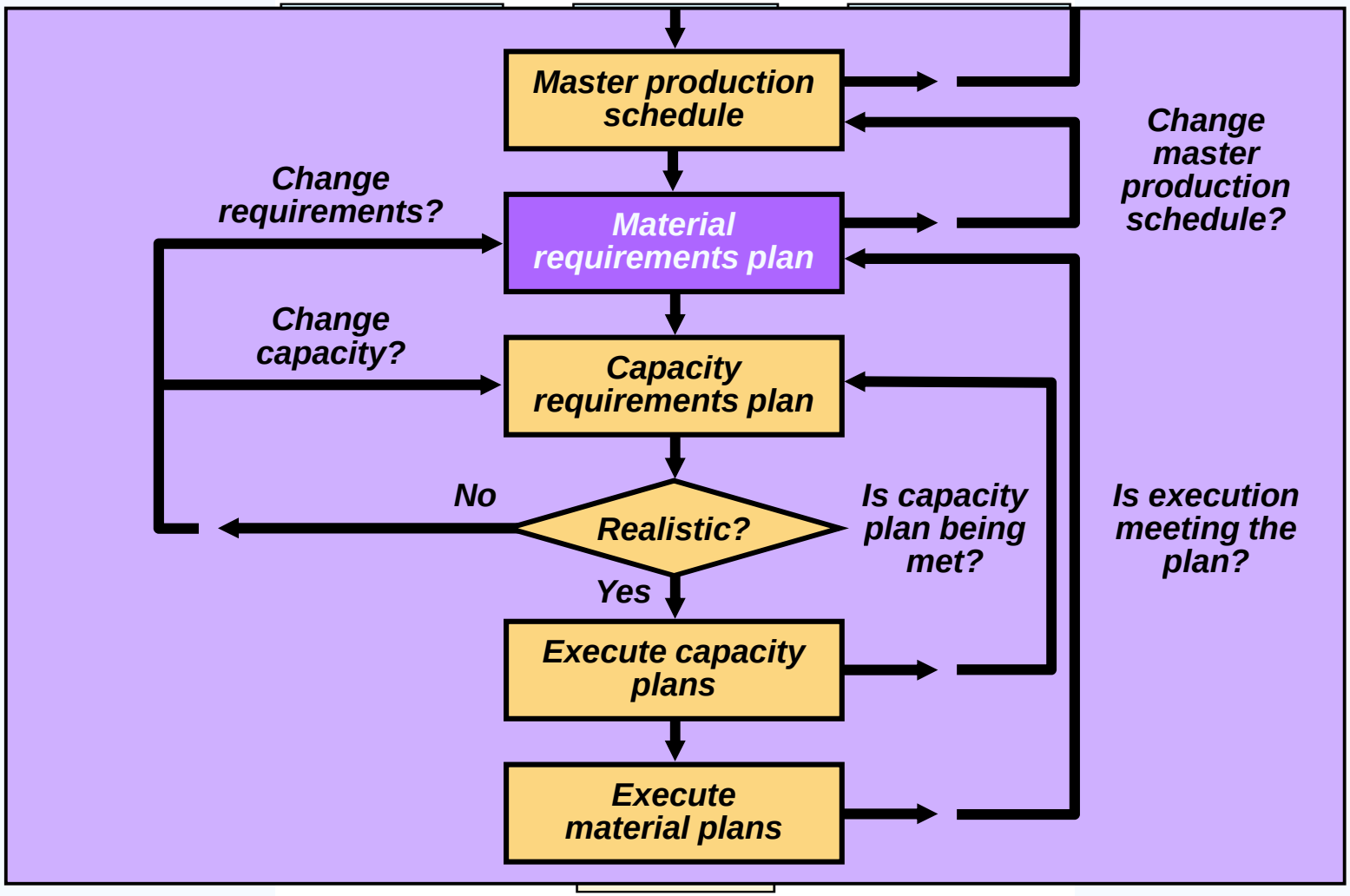


Figure 14.1

Aggregate Production Plan

Months	January				February			
Aggregate Production Plan (Shows the total quantity of amplifiers)	1,500				1,200			
Weeks	1	2	3	4	5	6	7	8
Master Production Schedule (Shows the specific type and quantity of amplifier to be produced								
240-watt amplifier	100		100		100		100	
150-watt amplifier		500		500		450		450
75-watt amplifier			300				100	

Figure 14.2

Master Production Schedule (MPS)

Can be expressed in any of the following terms:

- ☑ ***A customer order in a job shop (make-to-order) company***
- ☑ ***Modules in a repetitive (assemble-to-order or forecast) company***
- ☑ ***An end item in a continuous (stock-to-forecast) company***

Focus for Different Process Strategies

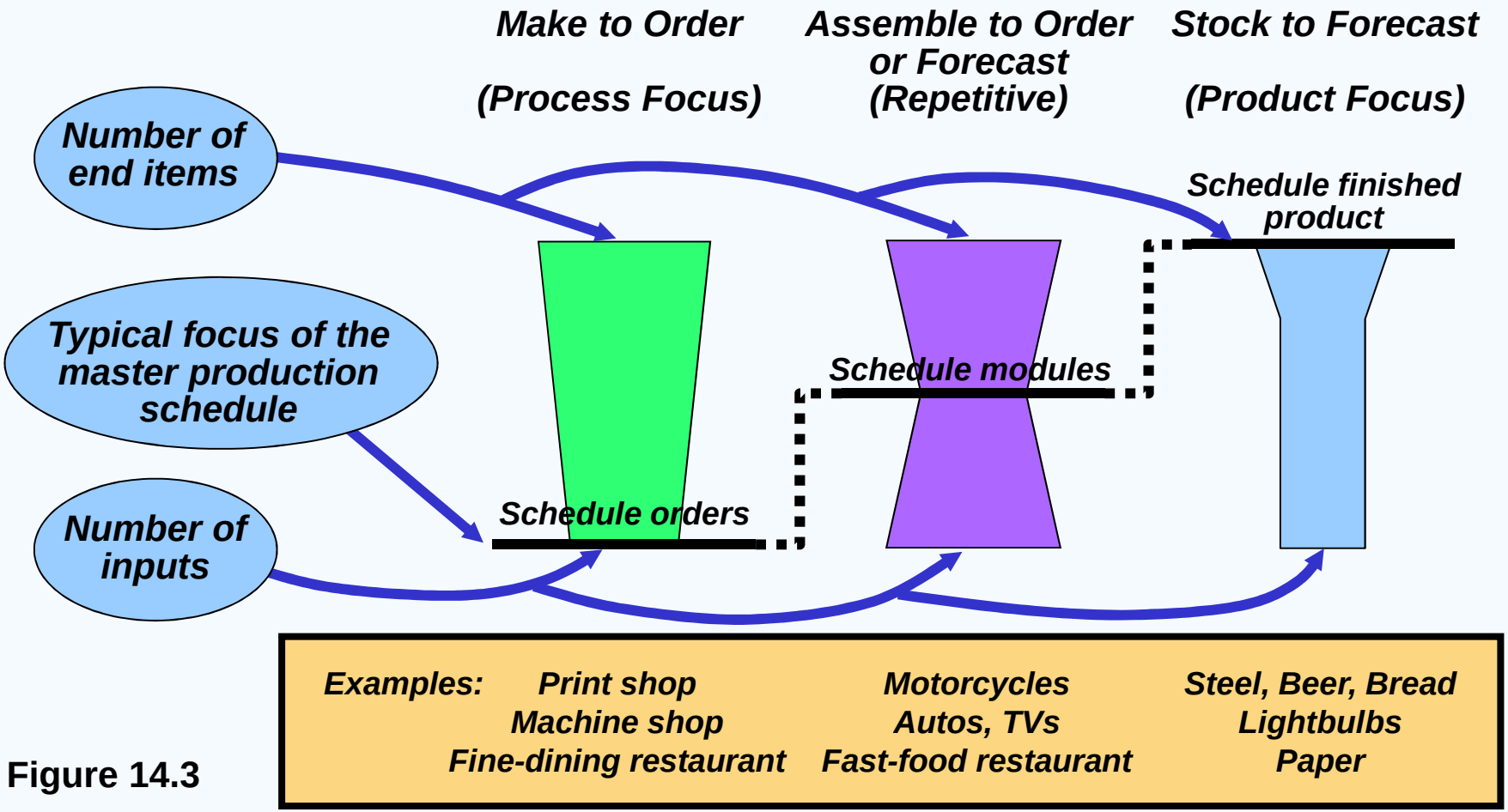


Figure 14.3

MPS Examples

For Nancy's Specialty Foods

Gross Requirements for Crabmeat Quiche										
Day	6	7	8	9	10	11	12	13	14	and so on
Amount	50		100	47	60		110	75		

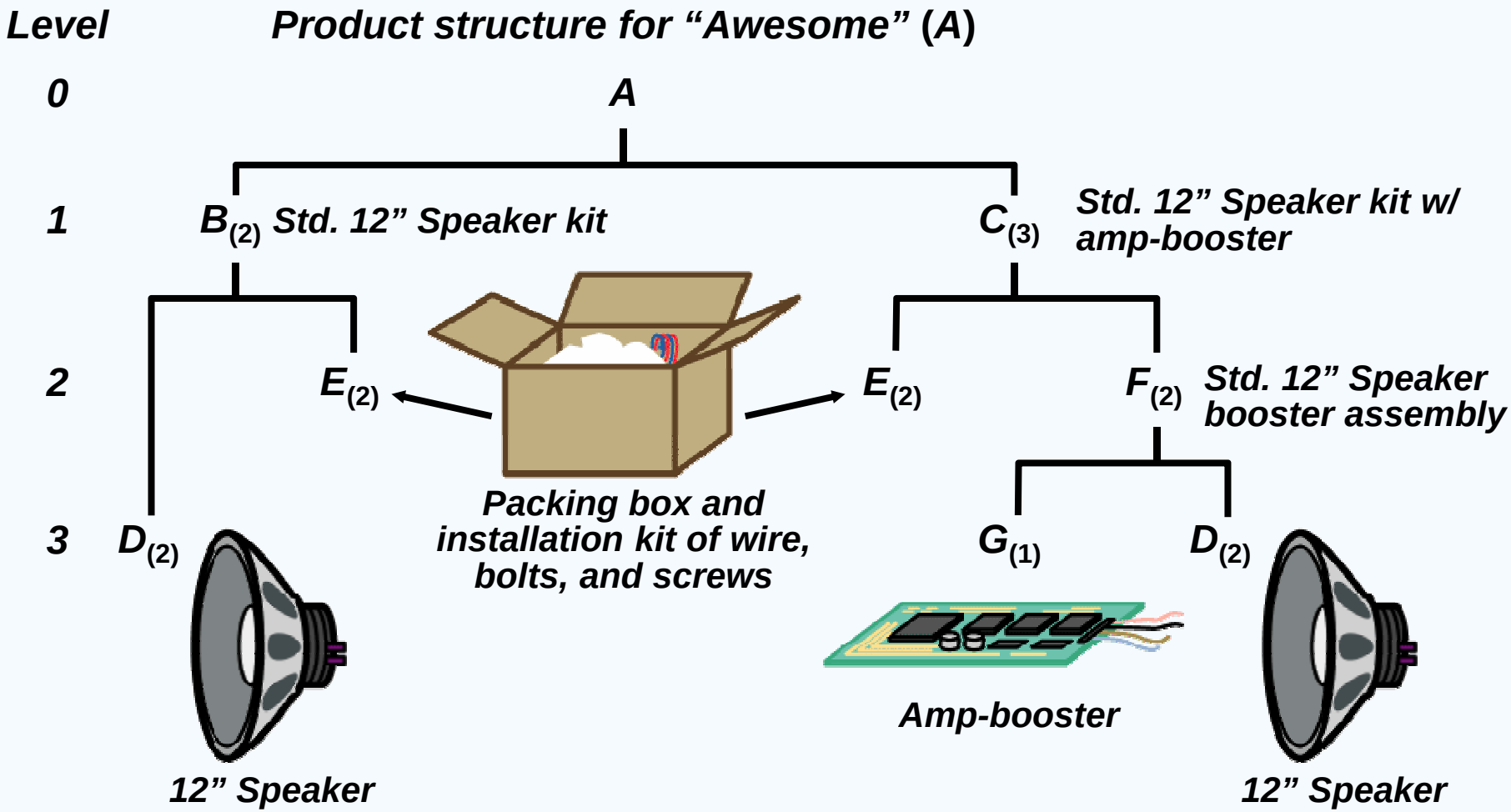
Gross Requirements for Spinach Quiche											
Day	7	8	9	10	11	12	13	14	15	16	and so on
Amount	100	200	150			60	75		100		

Table 14.1

Bills of Material

- ***List of components, ingredients, and materials needed to make product***
- ***Provides product structure***
  - ***Items above given level are called parents***
  - ***Items below given level are called children***

BOM Example



BOM Example

Level *Product structure for "Awesome" (A)*

0

1

2

3 *D*

Part B:	*2 x number of As =*	*(2)(50) =*	*100*
Part C:	*3 x number of As =*	*(3)(50) =*	*150*
Part D:	*2 x number of Bs*		
	+ 2 x number of Fs =	*(2)(100) + (2)(300) =*	*800*
Part E:	*2 x number of Bs*		
	+ 2 x number of Cs =	*(2)(100) + (2)(150) =*	*500*
Part F:	*2 x number of Cs =*	*(2)(150) =*	*300*
Part G:	*1 x number of Fs =*	*(1)(300) =*	*300*

Amp-booster

12" Speaker

12" Speaker

Bills of Material

- ***Modular Bills***
  - ***Modules are not final products but components that can be assembled into multiple end items***
  - ***Can significantly simplify planning and scheduling***

Bills of Material

- ***Planning Bills (Pseudo Bills)***
  - ***Created to assign an artificial parent to the BOM***
  - ***Used to group subassemblies to reduce the number of items planned and scheduled***
  - ***Used to create standard "kits" for production***

Bills of Material

- ☑ *Phantom Bills*
  - ☑ *Describe subassemblies that exist only temporarily*
  - ☑ *Are part of another assembly and never go into inventory*
- ☑ *Low-Level Coding*
  - ☑ *Item is coded at the lowest level at which it occurs*
  - ☑ *BOMs are processed one level at a time*

Accurate Records

- ☑ *Accurate inventory records are absolutely required for MRP (or any dependent demand system) to operate correctly*
- ☑ *Generally MRP systems require 99% accuracy*
- ☑ *Outstanding purchase orders must accurately reflect quantities and scheduled receipts*

Lead Times

- ***The time required to purchase, produce, or assemble an item***
  - ***For production – the sum of the order, wait, move, setup, store, and run times***
  - ***For purchased items – the time between the recognition of a need and the availability of the item for production***

Time-Phased Product Structure

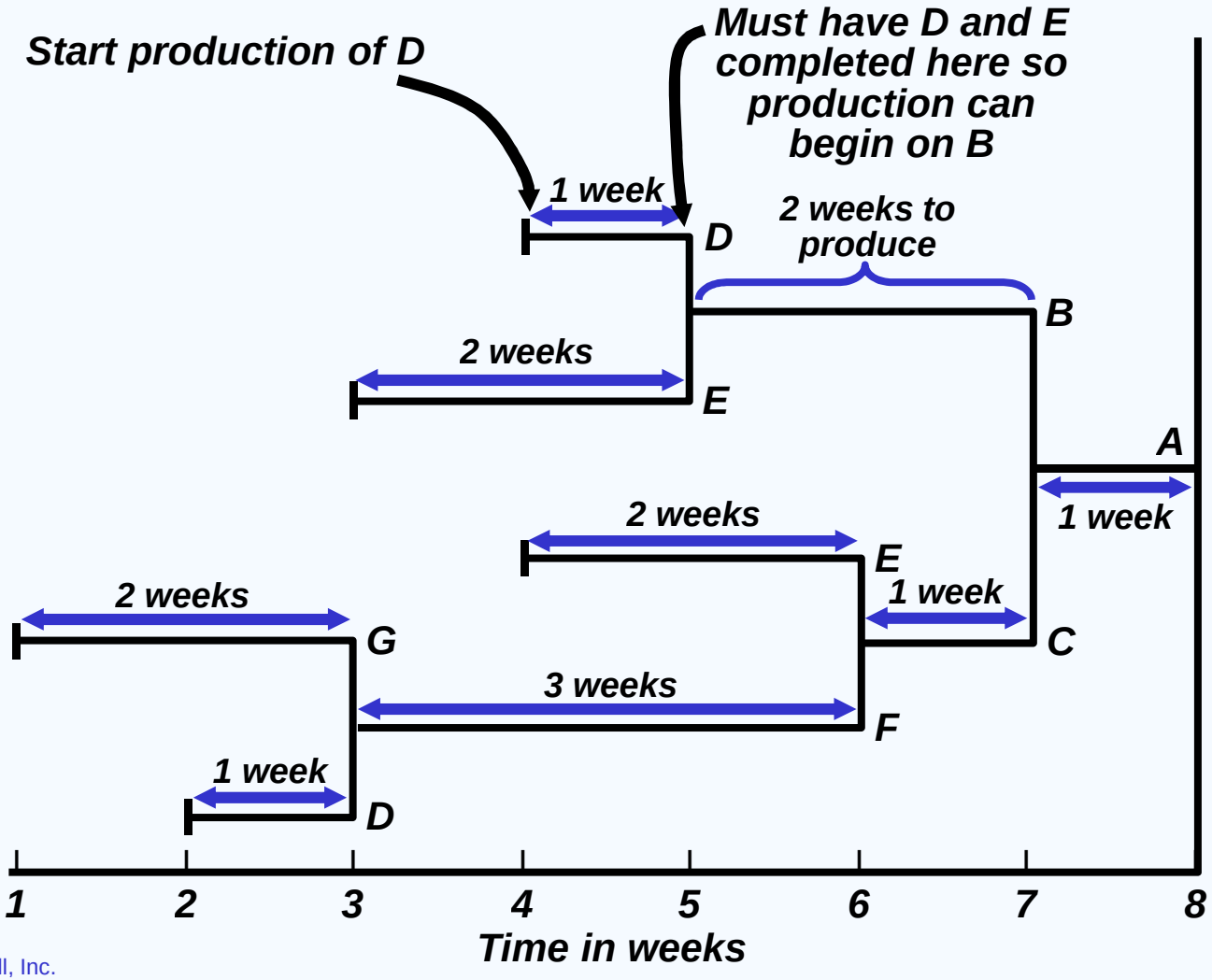


Figure 14.4

MRP Structure

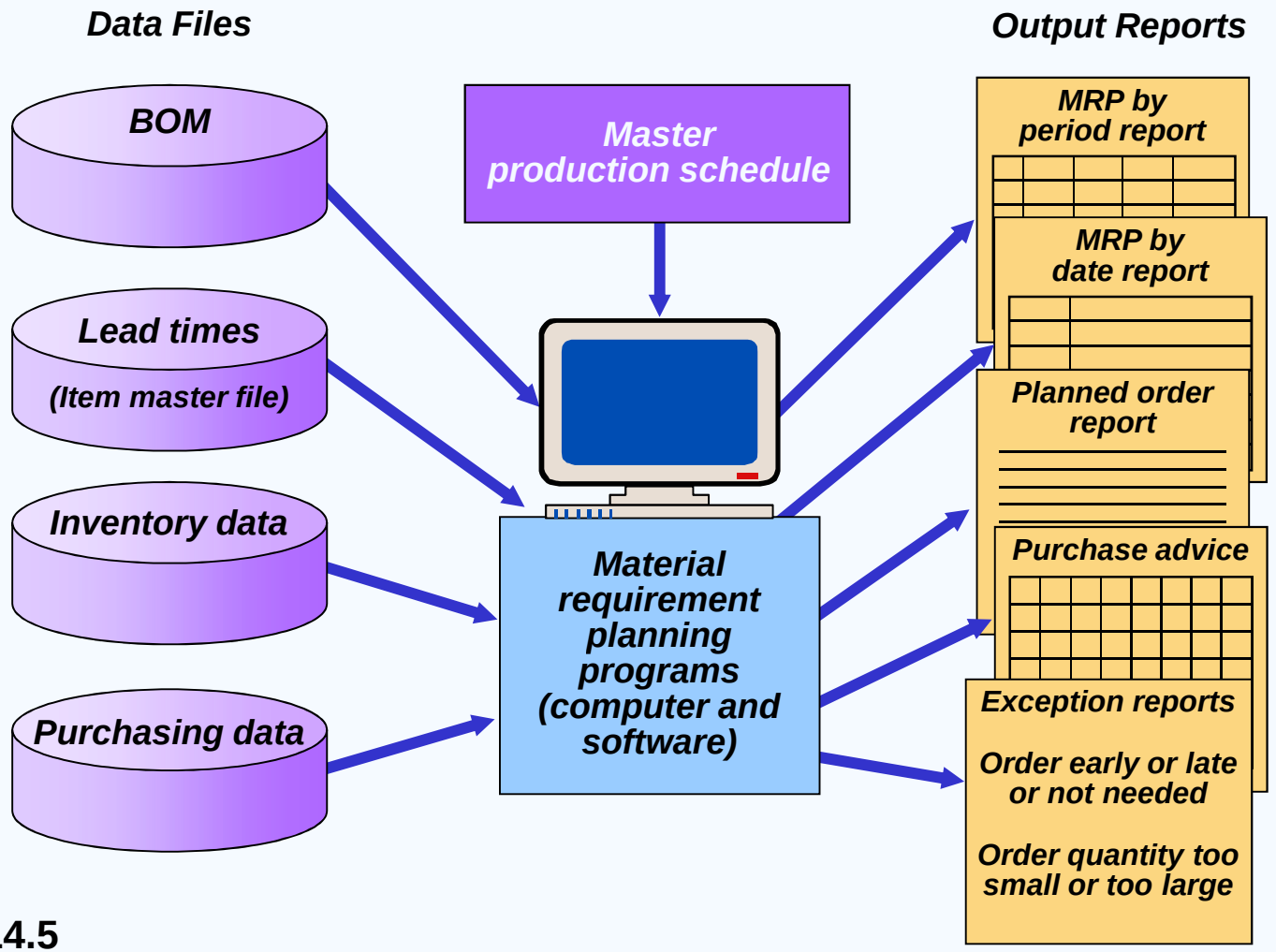


Figure 14.5

Safety Stock

- ☑ *BOMs, inventory records, purchase and production quantities may not be perfect*
- ☑ *Consideration of safety stock may be prudent*
- ☑ *Should be minimized and ultimately eliminated*
- ☑ *Typically built into projected on-hand inventory*

MRP Management

- ☑ *MRP is a dynamic system*
- ☑ *Facilitates replanning when changes occur*
- ☑ *System nervousness can result from too many changes*
- ☑ *Time fences put limits on replanning*
- ☑ *Pegging links each item to its parent allowing effective analysis of changes*

MRP and JIT

- ☑ ***MRP is a planning system that does not do detailed scheduling***
- ☑ ***MRP requires fixed lead times which might actually vary with batch size***
- ☑ ***JIT excels at rapidly moving small batches of material through the system***

Operations Management

Chapter 6 – Managing Quality

PowerPoint presentation to accompany
Heizer/Render
Principles of Operations Management, 7e
Operations Management, 9e

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Quality and Strategy

- ☑ *Managing quality supports differentiation, low cost, and response strategies*
- ☑ *Quality helps firms increase sales and reduce costs*
- ☑ *Building a quality organization is a demanding task*

Two Ways Quality Improves Profitability

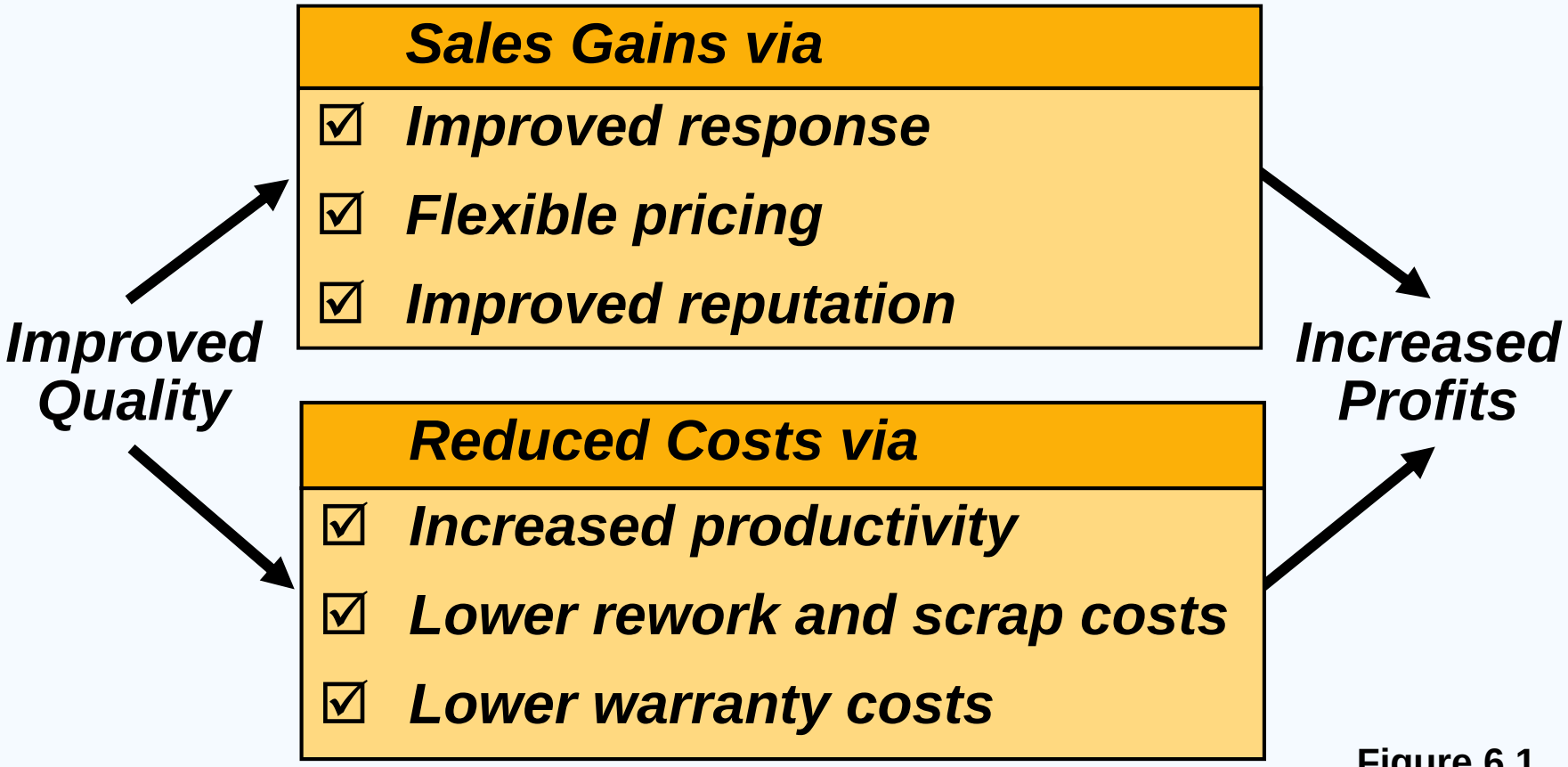


Figure 6.1

The Flow of Activities

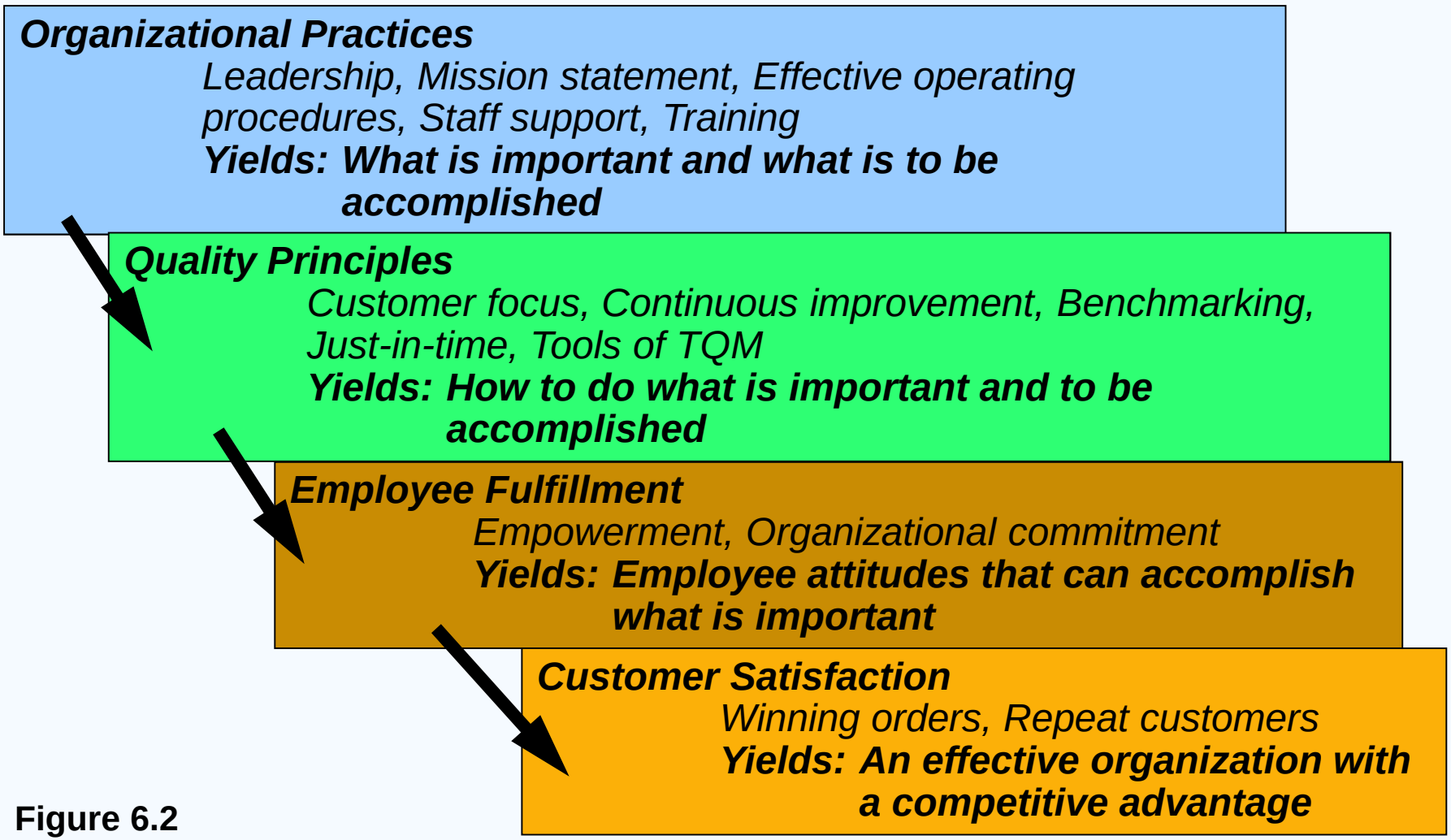


Figure 6.2

Defining Quality

The totality of features and characteristics of a product or service that bears on its ability to satisfy stated or implied needs

American Society for Quality

Different Views

- ☑ *User-based – better performance, more features*
- ☑ *Manufacturing-based – conformance to standards, making it right the first time*
- ☑ *Product-based – specific and measurable attributes of the product*

Implications of Quality

1. Company reputation
   - ☑ Perception of new products
   - ☑ Employment practices
   - ☑ Supplier relations
2. Product liability
   - ☑ Reduce risk
3. Global implications
   - ☑ Improved ability to compete

Key Dimensions of Quality

- ☑ *Performance*
- ☑ *Features*
- ☑ *Reliability*
- ☑ *Conformance*
- ☑ *Durability*
- ☑ *Serviceability*
- ☑ *Aesthetics*
- ☑ *Perceived quality*
- ☑ *Value*

Malcom Baldrige National Quality Award

- ☑ Established in 1988 by the U.S. government
- ☑ Designed to promote TQM practices
- ☑ Recent winners
  - ☑ Premier Inc., MESA Products, Sunny Fresh Foods, Park Place Lexus, North Mississippi Medical Center, The Bama Companies, Richland College, Texas Nameplate Company, Inc.

Baldrige Criteria

Applicants are evaluated on:

Categories	Points
Leadership	120
Strategic Planning	85
Customer & Market Focus	85
Measurement, Analysis, and Knowledge Management	90
Workforce Focus	85
Process Management	85
Results	450

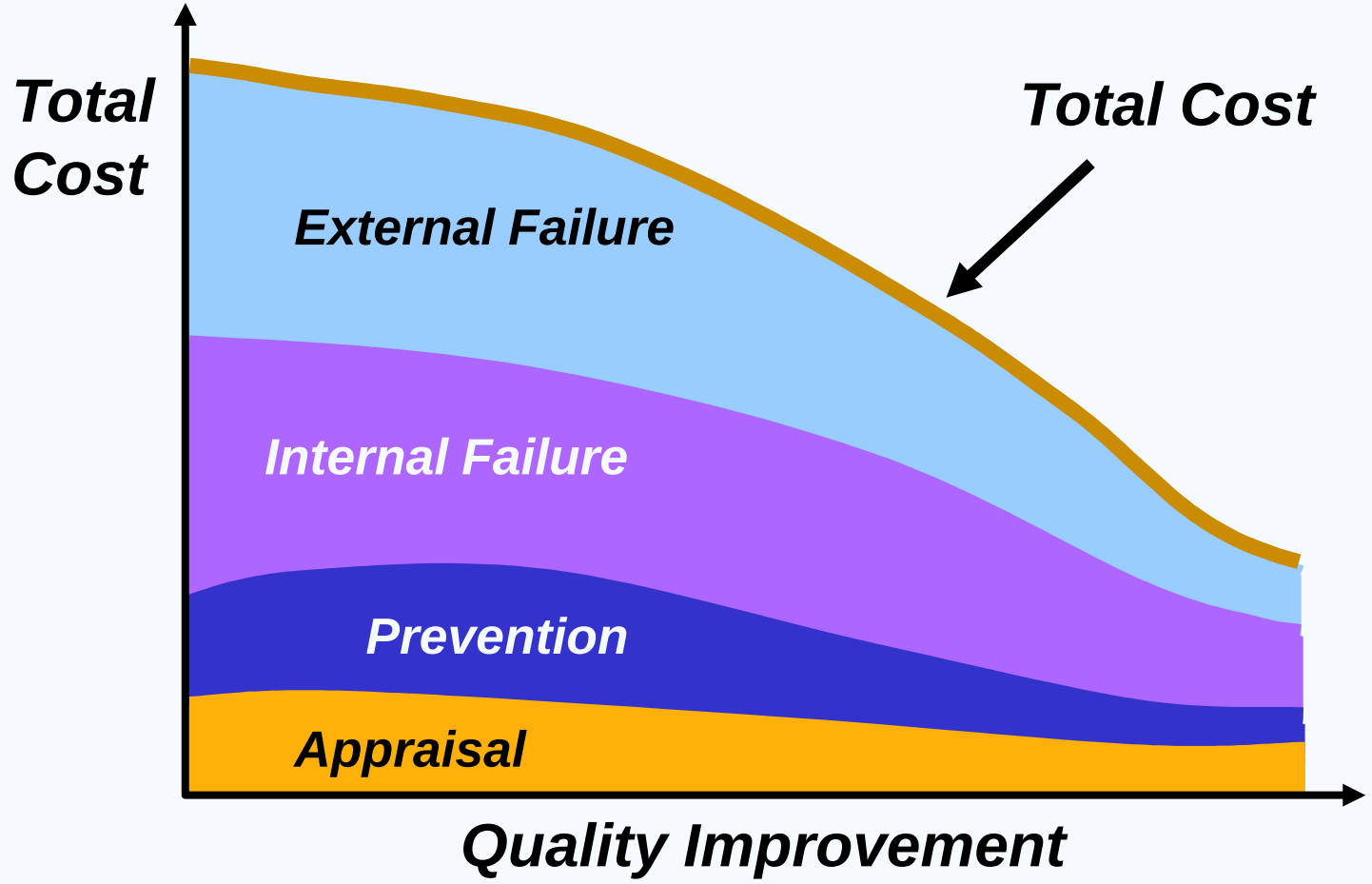
Takumi

A Japanese character that symbolizes a broader dimension than quality, a deeper process than education, and a more perfect method than persistence

Costs of Quality

- ☑ *Prevention costs - reducing the potential for defects*
- ☑ *Appraisal costs - evaluating products, parts, and services*
- ☑ *Internal failure - producing defective parts or service before delivery*
- ☑ *External costs - defects discovered after delivery*

Costs of Quality



Leaders in Quality

W. Edwards Deming	*14 Points for Management*
Joseph M. Juran	*Top management commitment, fitness for use*
Armand Feigenbaum	*Total Quality Control*
Philip B. Crosby	*Quality is Free, zero defects*

International Quality Standards

- ☑ *ISO 9000 series (Europe/EC)*
  - ☑ *Common quality standards for products sold in Europe (even if made in U.S.)*
  - ☑ *2000 update places greater emphasis on leadership and customer satisfaction*
- ☑ *ISO 14000 series (Europe/EC)*

ISO 14000 Environmental Standard

Core Elements:

- ☑ *Environmental management*
- ☑ *Auditing*
- ☑ *Performance evaluation*
- ☑ *Labeling*
- ☑ *Life cycle assessment*

TQM

Encompasses entire organization, from supplier to customer

Stresses a commitment by management to have a continuing, companywide drive toward excellence in all aspects of products and services that are important to the customer

Seven Concepts of TQM

- ☑ *Continuous improvement*
- ☑ *Six Sigma*
- ☑ *Employee empowerment*
- ☑ *Benchmarking*
- ☑ *Just-in-time (JIT)*
- ☑ *Taguchi concepts*
- ☑ *Knowledge of TQM tools*

Continuous Improvement

- ☑ ***Represents continual improvement of all processes***
- ☑ ***Involves all operations and work centers including suppliers and customers***
  - ☑ ***People, Equipment, Materials, Procedures***

Six Sigma

- ☑ ***Two meanings***
  - ☑ ***Statistical definition of a process that is 99.9997% capable, 3.4 defects per million opportunities (DPMO)***
  - ☑ ***A program designed to reduce defects, lower costs, and improve customer satisfaction***

Employee Empowerment

- ☑ *Getting employees involved in product and process improvements*
  - ☑ *85% of quality problems are due to process and material*
- ☑ *Techniques*
  - ☑ *Build communication networks that include employees*
  - ☑ *Develop open, supportive supervisors*
  - ☑ *Move responsibility to employees*
  - ☑ *Build a high-morale organization*
  - ☑ *Create formal team structures*

Benchmarking

Selecting best practices to use as a standard for performance

- ☑ ***Determine what to benchmark***
- ☑ ***Form a benchmark team***
- ☑ ***Identify benchmarking partners***
- ☑ ***Collect and analyze benchmarking information***
- ☑ ***Take action to match or exceed the benchmark***

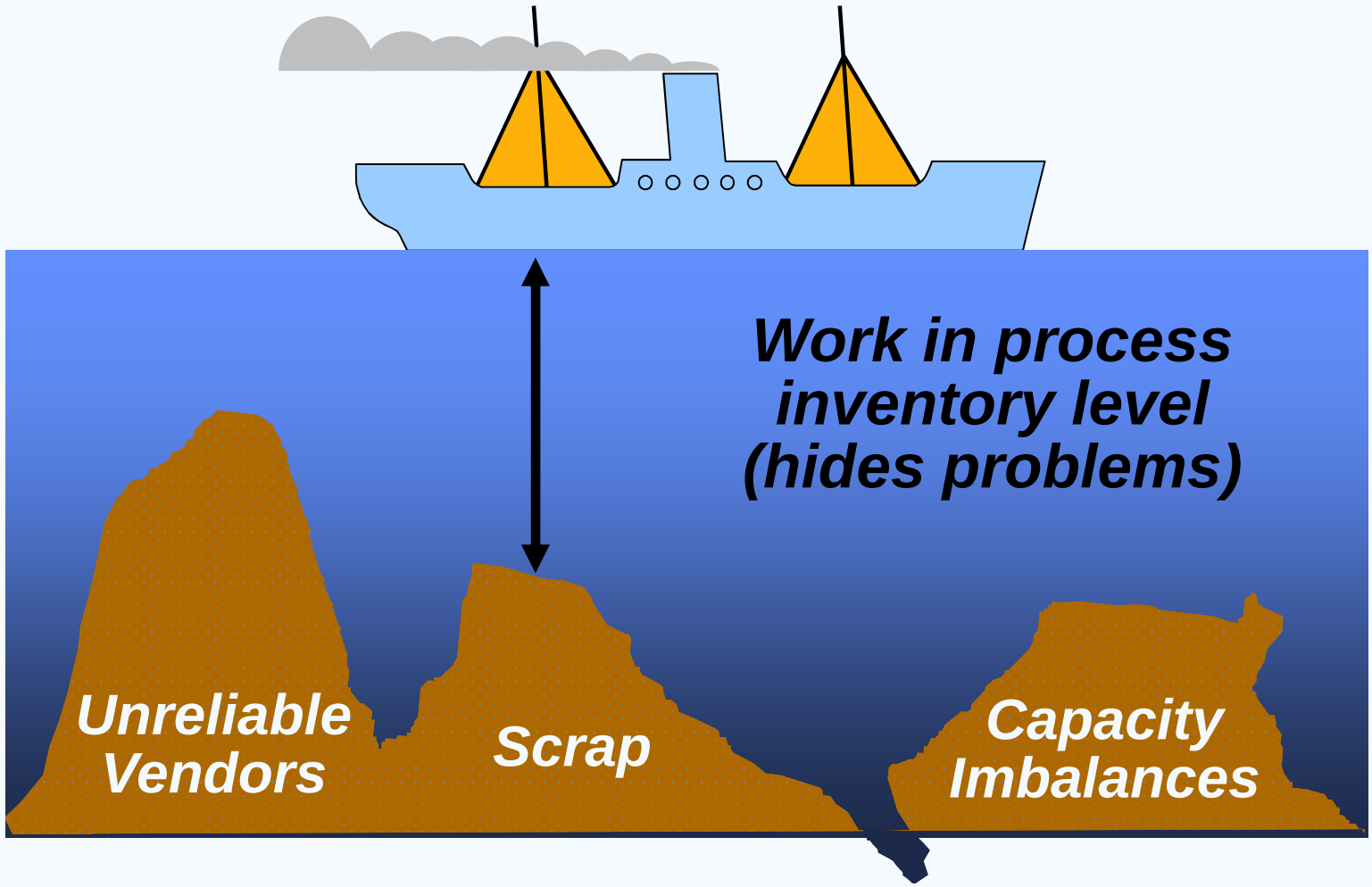
Use internal benchmarking if you're big enough

Just-in-Time (JIT)

Relationship to quality:

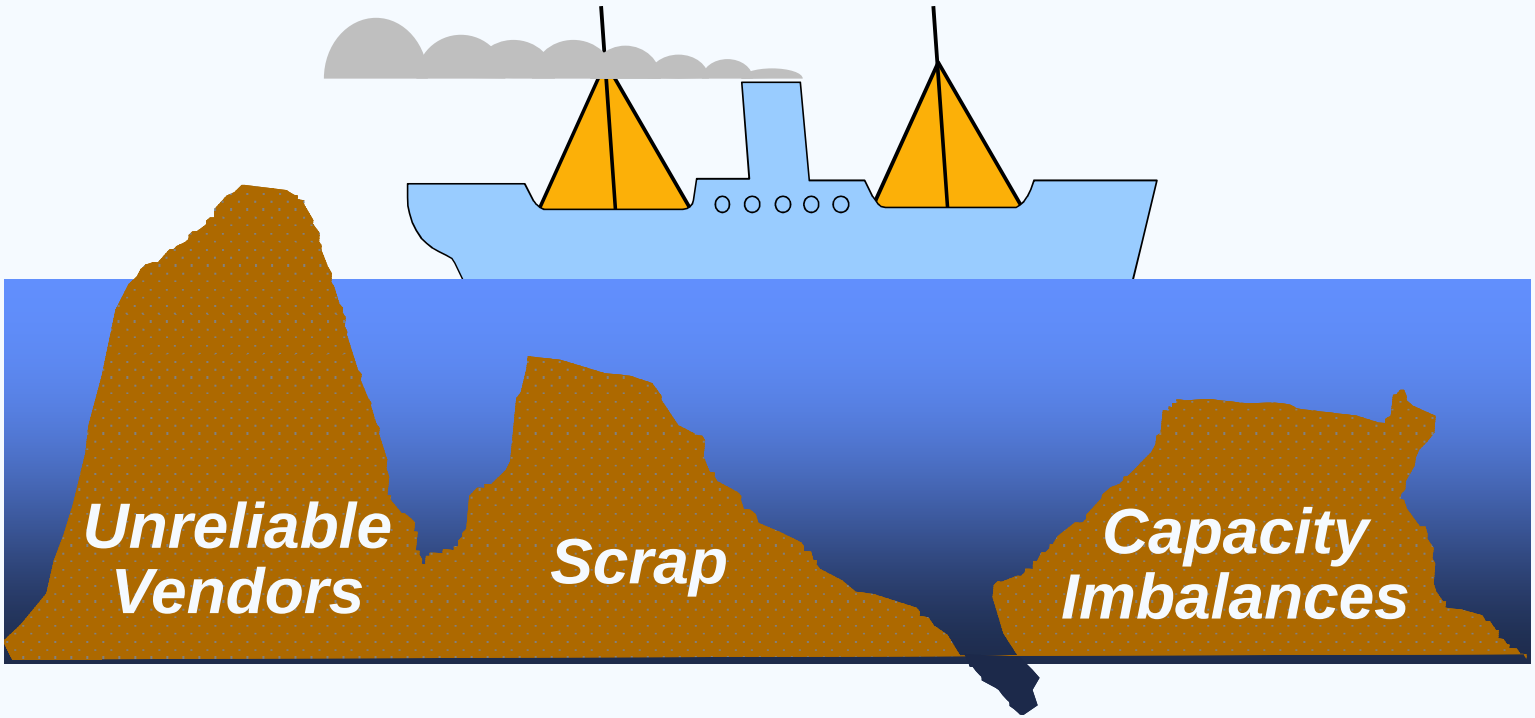
- ☑ ***JIT cuts the cost of quality***
- ☑ ***JIT improves quality***
- ☑ ***Better quality means less inventory and better, easier-to-employ JIT system***

Just-In-Time (JIT) Example



Just-In-Time (JIT) Example

Reducing inventory reveals problems so they can be solved



Taguchi Concepts

- ☑ *Engineering and experimental design methods to improve product and process design*
  - ☑ *Identify key component and process variables affecting product variation*
- ☑ *Taguchi Concepts*
  - ☑ *Quality robustness*
  - ☑ *Quality loss function*
  - ☑ *Target-oriented quality*

Quality Loss Function

- ☑ *Shows that costs increase as the product moves away from what the customer wants*
- ☑ *Costs include customer dissatisfaction, warranty and service, internal scrap and repair, and costs to society*
- ☑ *Traditional conformance specifications are too simplistic*

Target-oriented quality

Tools of TQM

- ☑ *Tools for Generating Ideas*
  - ☑*Check sheets*
  - ☑*Scatter diagrams*
  - ☑*Cause-and-effect diagrams*
- ☑ *Tools to Organize the Data*
  - ☑*Pareto charts*
  - ☑*Flowcharts*
- ☑ *Tools for Identifying Problems*
  - ☑*Histogram*
  - ☑*Statistical process control chart*

Seven Tools of TQM

(a) Check Sheet: An organized method of recording data

	Hour							
Defect	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
A	///	/		/	/	/	///	/
B	//	/	/	/			//	///
C	/	//					//	////

Figure 6.6

Seven Tools of TQM

(b) Scatter Diagram: A graph of the value of one variable vs. another variable

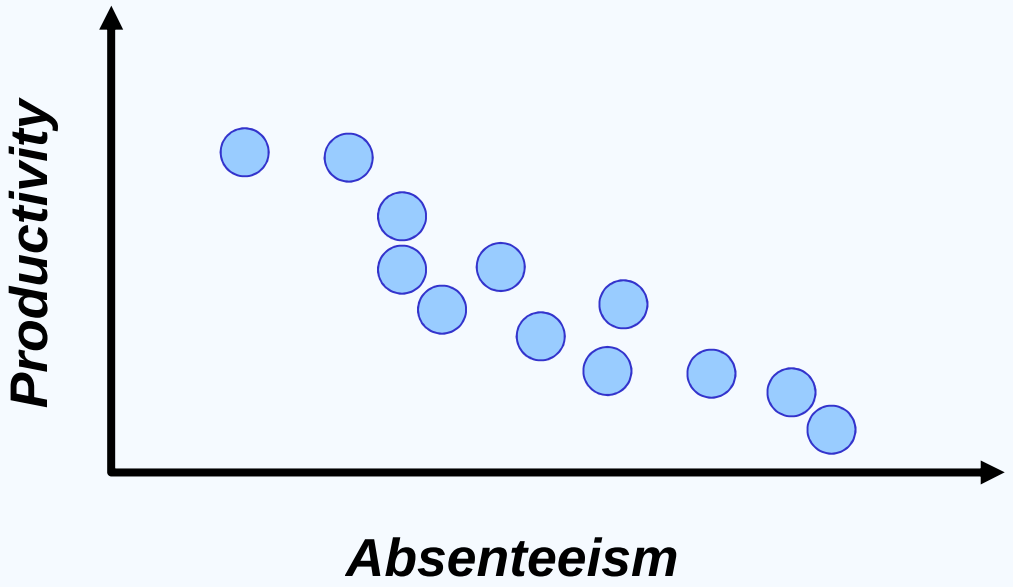


Figure 6.6

Seven Tools of TQM

(c) Cause-and-Effect Diagram: A tool that identifies process elements (causes) that might effect an outcome

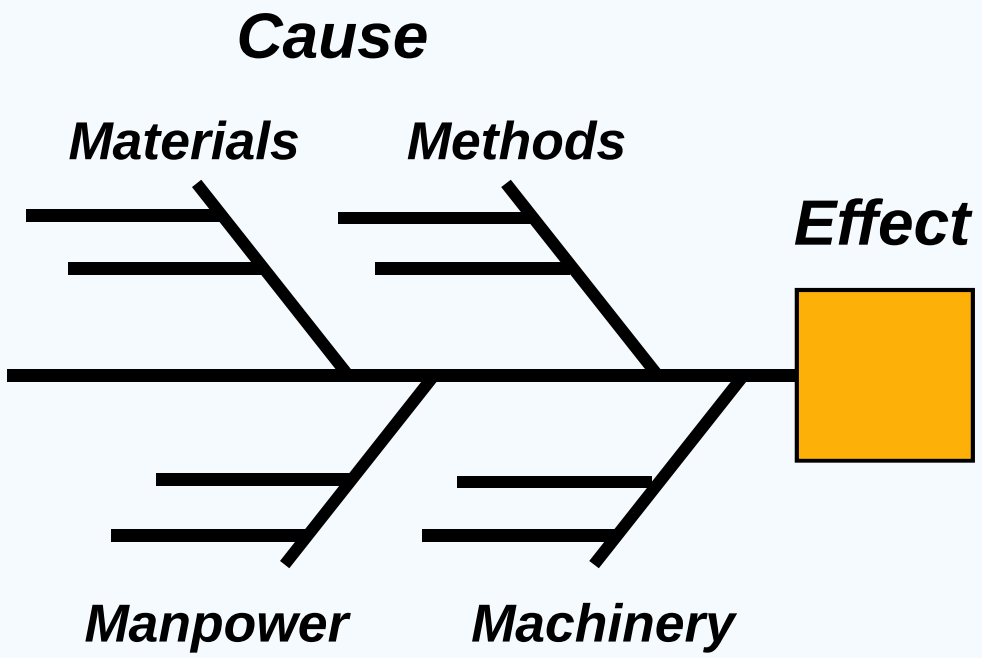


Figure 6.6

Seven Tools of TQM

(d) Pareto Chart: A graph to identify and plot problems or defects in descending order of frequency

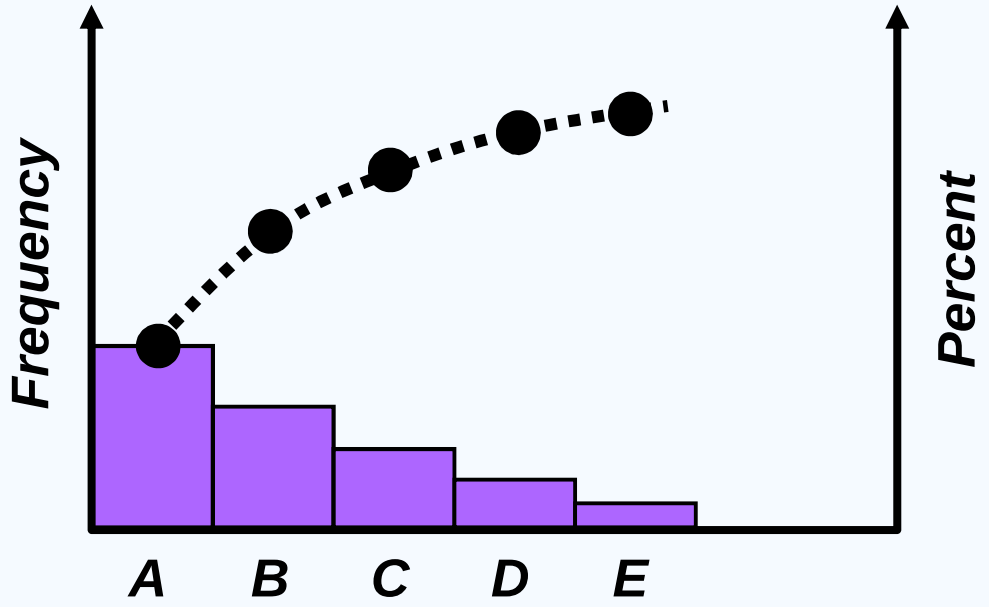


Figure 6.6

Seven Tools of TQM

(e) Flowchart (Process Diagram): A chart that describes the steps in a process

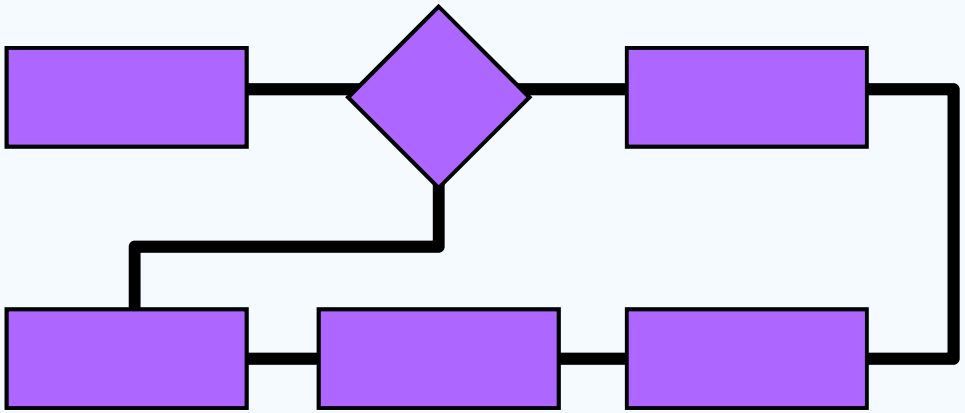


Figure 6.6

Seven Tools of TQM

(f) Histogram: A distribution showing the frequency of occurrences of a variable

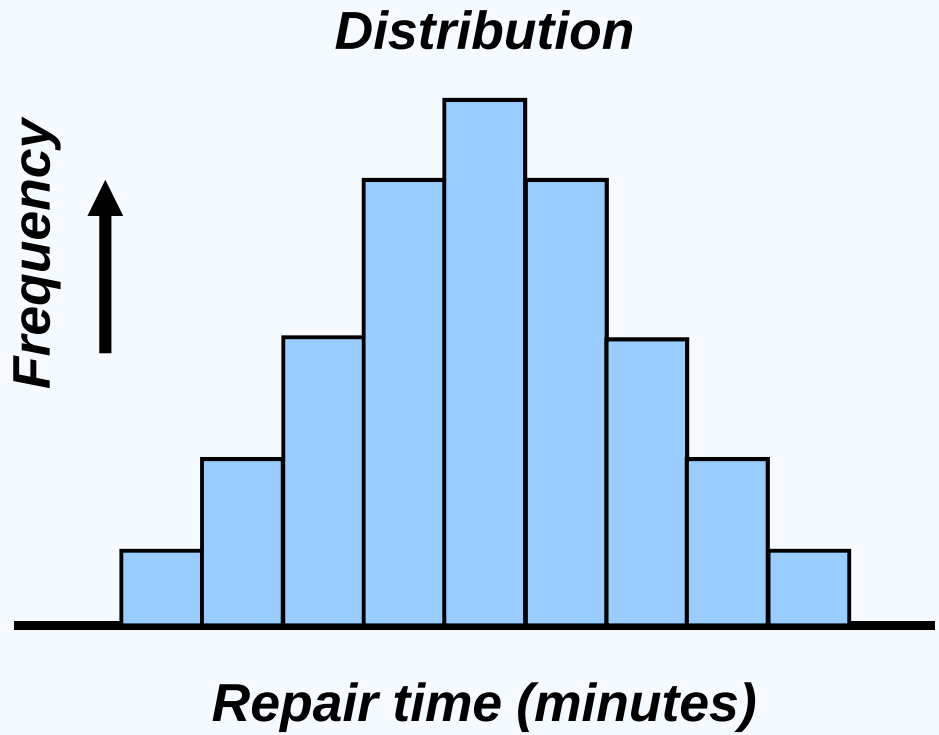


Figure 6.6

Seven Tools of TQM

(g) Statistical Process Control Chart: A chart with time on the horizontal axis to plot values of a statistic

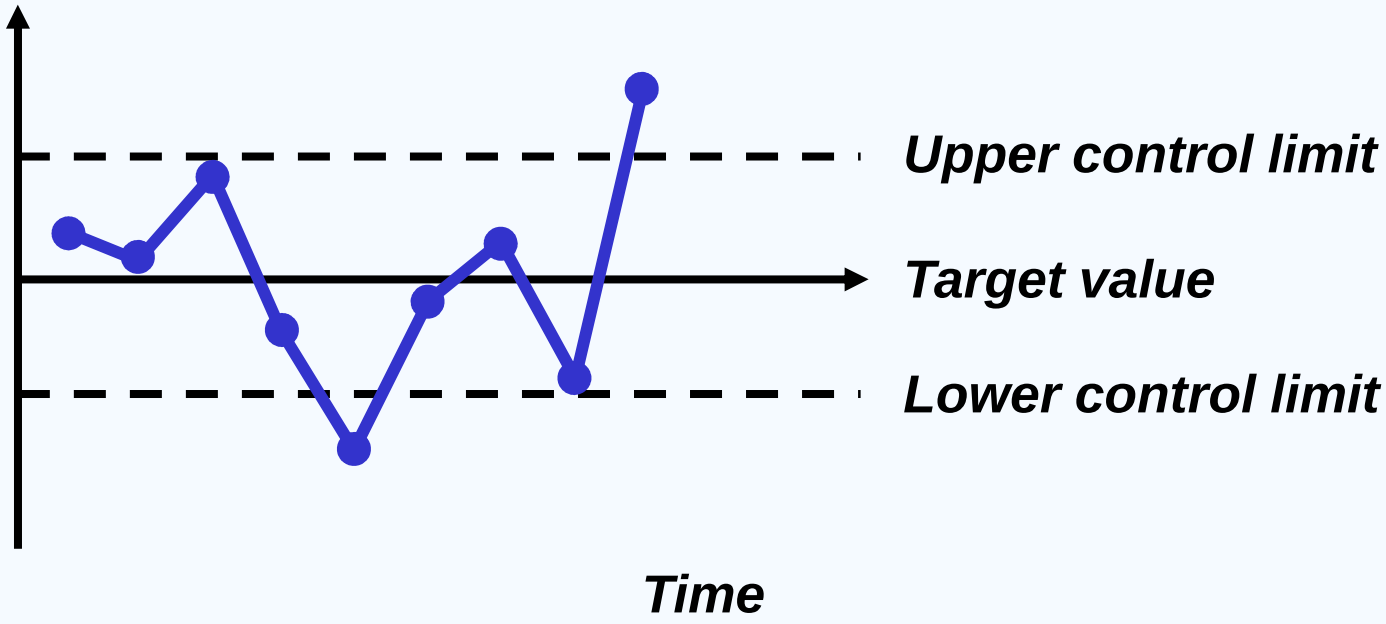


Figure 6.6

Cause-and-Effect Diagrams

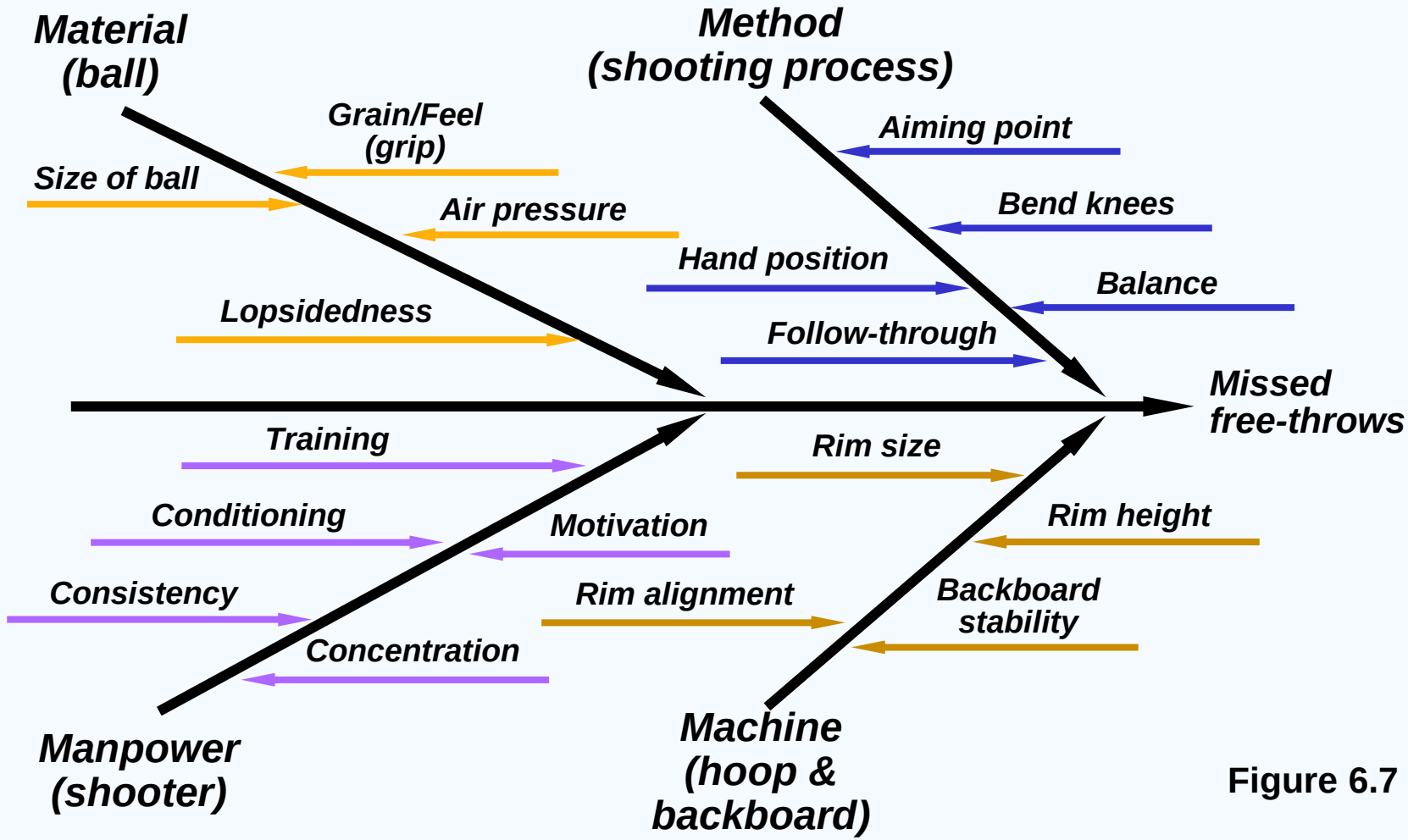
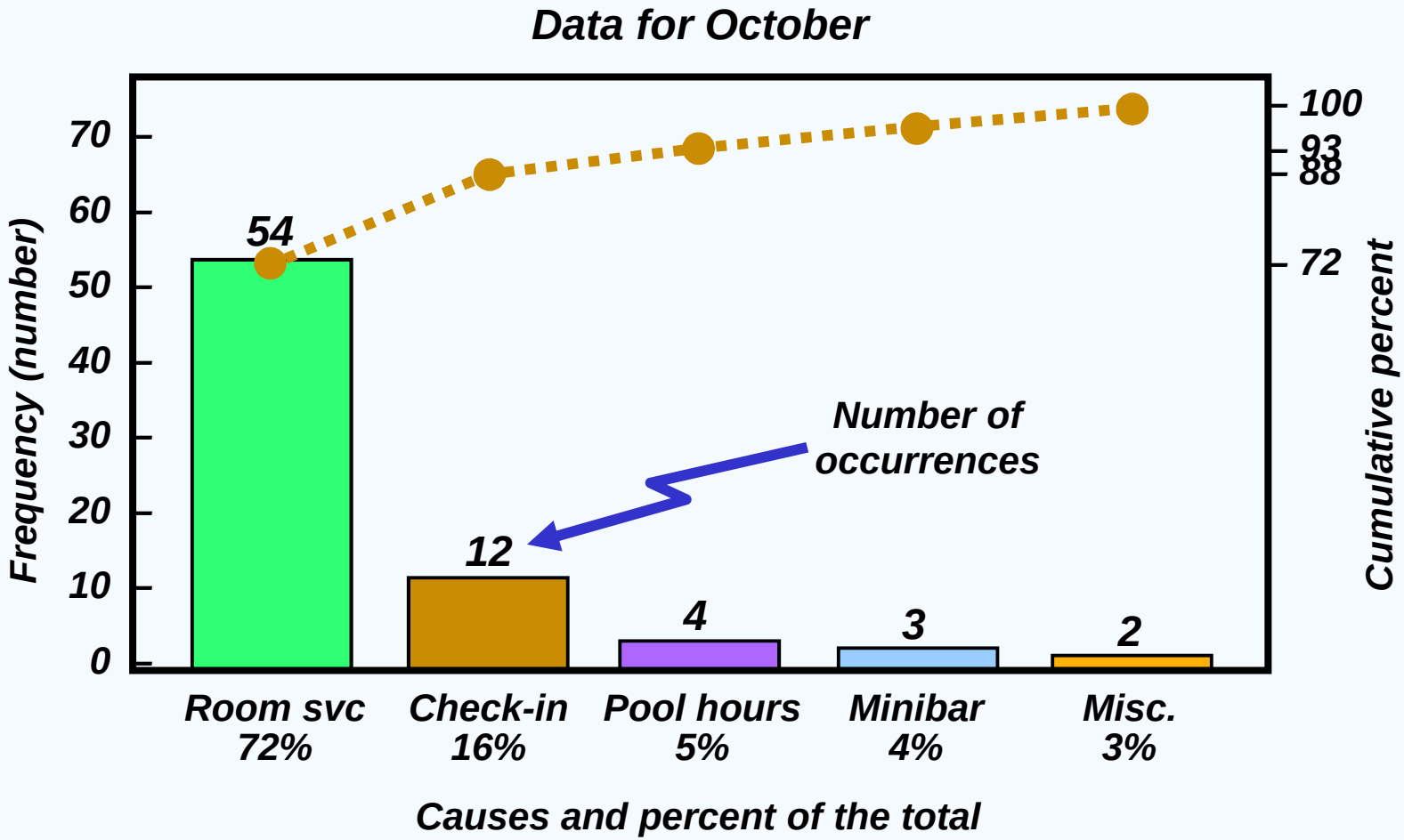


Figure 6.7

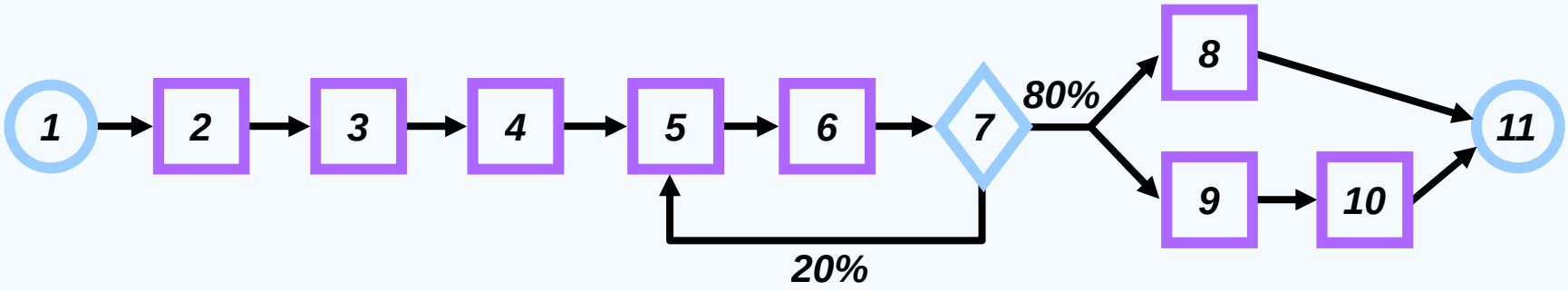
Pareto Charts



Flow Charts

MRI Flowchart

1. Physician schedules MRI
2. Patient taken to MRI
3. Patient signs in
4. Patient is prepped
5. Technician carries out MRI
6. Technician inspects film
7. If unsatisfactory, repeat
8. Patient taken back to room
9. MRI read by radiologist
10. MRI report transferred to physician
11. Patient and physician discuss



Statistical Process Control (SPC)

- ☑ *Uses statistics and control charts to tell when to take corrective action*
- ☑ *Drives process improvement*
- ☑ *Four key steps*
  - ☑ *Measure the process*
  - ☑ *When a change is indicated, find the assignable cause*
  - ☑ *Eliminate or incorporate the cause*
  - ☑ *Restart the revised process*

An SPC Chart

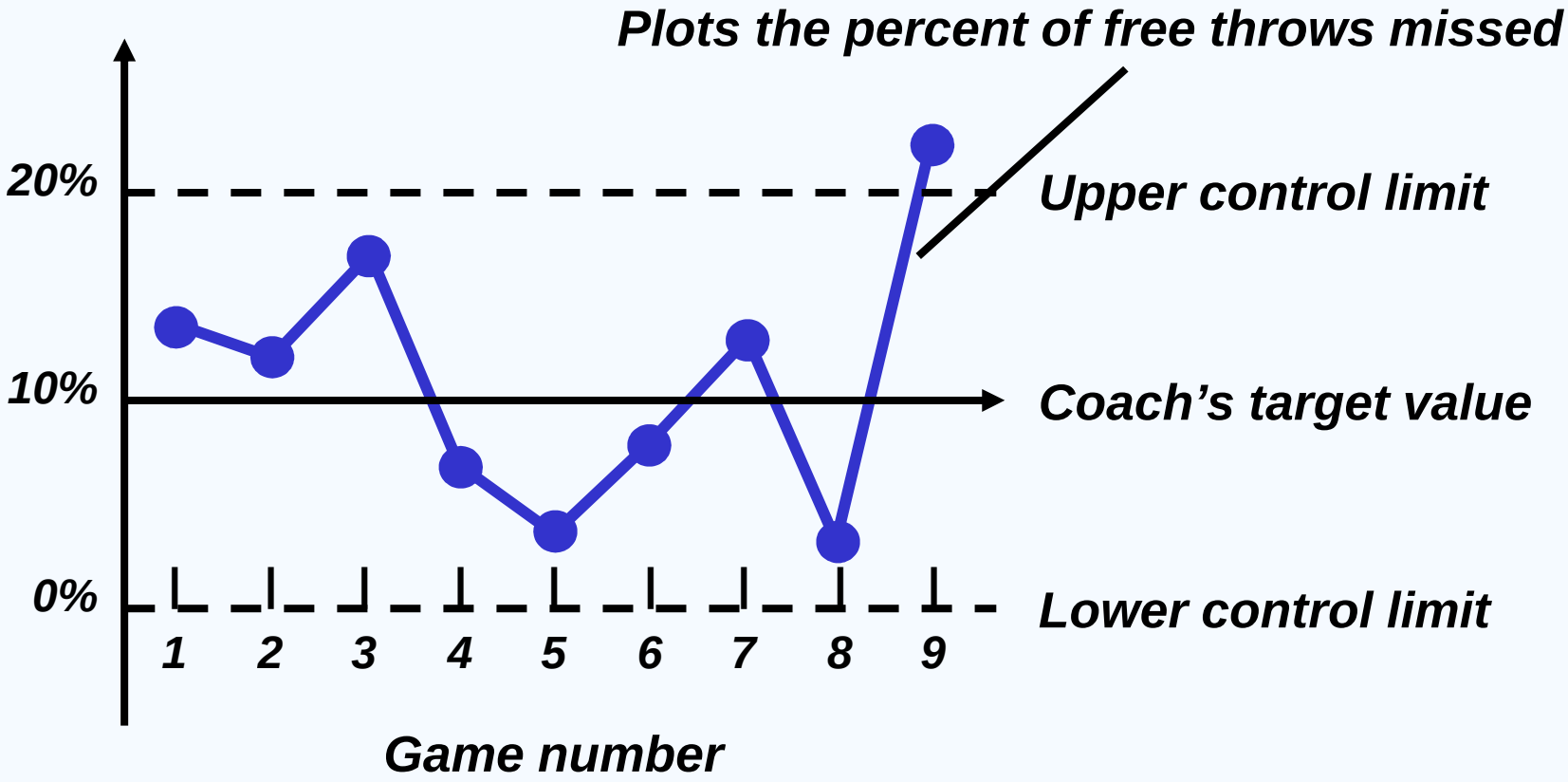


Figure 6.8

Statistical Process Control (SPC)

- ☑ ***Variability is inherent in every process***
  - ☑ ***Natural or common causes***
  - ☑ ***Special or assignable causes***
- ☑ ***Provides a statistical signal when assignable causes are present***
- ☑ ***Detect and eliminate assignable causes of variation***

Natural Variations

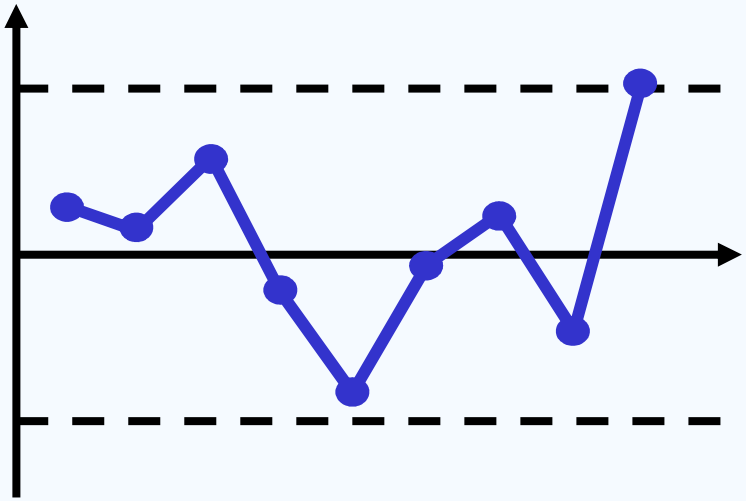
- ☑ *Also called common causes*
- ☑ *Affect virtually all production processes*
- ☑ *Expected amount of variation*
- ☑ *Output measures follow a probability distribution*
- ☑ *For any distribution there is a measure of central tendency and dispersion*
- ☑ *If the distribution of outputs falls within acceptable limits, the process is said to be “in control”*

Assignable Variations

- ☑ *Also called special causes of variation*
  - ☑ *Generally this is some change in the process*
- ☑ *Variations that can be traced to a specific reason*
- ☑ *The objective is to discover when assignable causes are present*
  - ☑ *Eliminate the bad causes*
  - ☑ *Incorporate the good causes*

Control Charts

Constructed from historical data, the purpose of control charts is to help distinguish between natural variations and variations due to assignable causes



Types of Data

Variables

- ☑ *Characteristics that can take any real value*
- ☑ *May be in whole or in fractional numbers*
- ☑ *Continuous random variables*

Attributes

- ☑ *Defect-related characteristics*
- ☑ *Classify products as either good or bad or count defects*
- ☑ *Categorical or discrete random variables*

Setting Chart Limits

For $\bar{x}$-Charts when we know σ

$$\text{Upper control limit (UCL)} = \bar{\bar{x}} + z\sigma_{\bar{x}}$$

$$\text{Lower control limit (LCL)} = \bar{\bar{x}} - z\sigma_{\bar{x}}$$

where $\bar{\bar{x}}$ = mean of the sample means or a target value set for the process

z = number of normal standard deviations

$\sigma_{\bar{x}}$ = standard deviation of the sample means

$= \sigma/\sqrt{n}$

σ = population standard deviation

n = sample size

Setting Control Limits

Hour 1	
Sample Number	Weight of Oat Flakes
1	17
2	13
3	16
4	18
5	17
6	16
7	15
8	17
9	16
Mean	16.1
σ =	1

$n = 9$

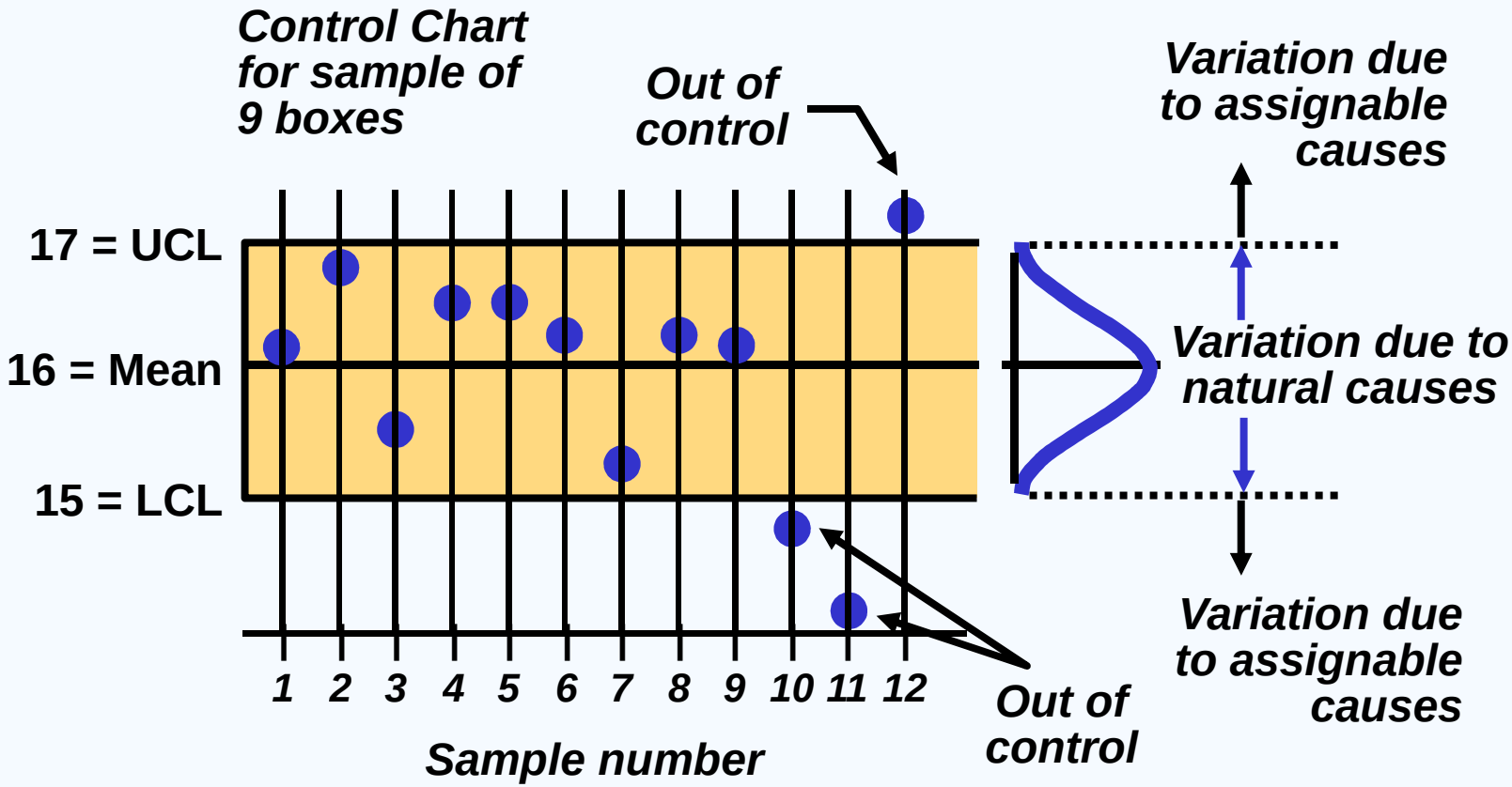
Hour	Mean	Hour	Mean
1	16.1	7	15.2
2	16.8	8	16.4
3	15.5	9	16.3
4	16.5	10	14.8
5	16.5	11	14.2
6	16.4	12	17.3

For 99.73% *control limits,* $z = 3$

$$UCL_{\bar{x}} = \bar{\bar{x}} + z\sigma_{\bar{x}} = 16 + 3(1/3) = 17 \text{ ozs}$$

$$LCL_{\bar{x}} = \bar{\bar{x}} - z\sigma_{\bar{x}} = 16 - 3(1/3) = 15 \text{ ozs}$$

Setting Control Limits



Setting Chart Limits

For $\bar{x}$-Charts when we don't know σ

$$\text{Upper control limit (UCL)} = \bar{\bar{x}} + A_2\bar{R}$$

$$\text{Lower control limit (LCL)} = \bar{\bar{x}} - A_2\bar{R}$$

where $\bar{R}$ = average range of the samples

A_2 = control chart factor found in Table S6.1

$\bar{\bar{x}}$ = mean of the sample means

Control Chart Factors

Sample Size n	Mean Factor A_2	Upper Range D_4	Lower Range D_3
2	1.880	3.268	0
3	1.023	2.574	0
4	.729	2.282	0
5	.577	2.115	0
6	.483	2.004	0
7	.419	1.924	0.076
8	.373	1.864	0.136
9	.337	1.816	0.184
10	.308	1.777	0.223
12	.266	1.716	0.284

Table S6.1

Setting Control Limits

Process average $\bar{\bar{x}}$ **= 16.01** ***ounces***
Average range $\bar{R}$ **= .25**
Sample size n **= 5**

Setting Control Limits

Process average $\bar{\bar{x}}$ = 16.01 *ounces*

Average range $\bar{R}$ = .25

Sample size n = 5

$$UCL_{\bar{x}} = \bar{\bar{x}} + A_2\bar{R}$$

$$= 16.01 + (.577)(.25)$$

$$= 16.01 + .144$$

$$= 16.154 \text{ ounces}$$

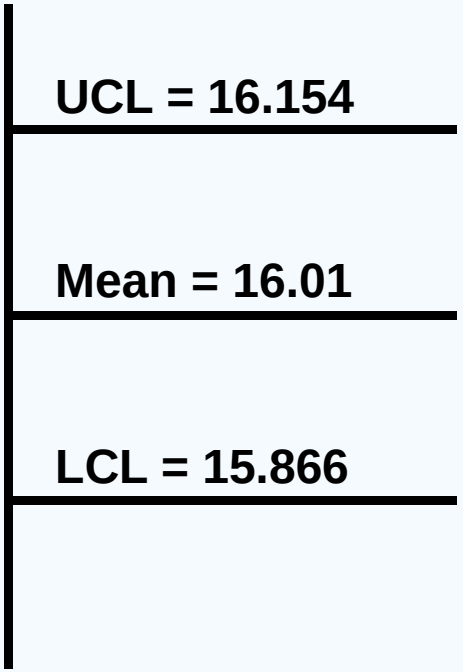
From Table S6.1

Setting Control Limits

Process average $\bar{\bar{x}}$ = 16.01 *ounces*
Average range $\bar{R}$ = .25
Sample size n = 5

$$UCL_{\bar{x}} = \bar{\bar{x}} + A_2\bar{R}$$
$$= 16.01 + (.577)(.25)$$
$$= 16.01 + .144$$
$$= 16.154 \text{ ounces}$$

$$LCL_{\bar{x}} = \bar{\bar{x}} - A_2\bar{R}$$
$$= 16.01 - .144$$
$$= 15.866 \text{ ounces}$$



R – Chart

- ☑ *Type of variables control chart*
- ☑ *Shows sample ranges over time*
  - ☑ *Difference between smallest and largest values in sample*
- ☑ *Monitors process variability*
- ☑ *Independent from process mean*

Setting Chart Limits

For R-Charts

$$\text{Upper control limit } (UCL_R) = D_4\bar{R}$$

$$\text{Lower control limit } (LCL_R) = D_3\bar{R}$$

where

$\bar{R}$ = *average range of the samples*

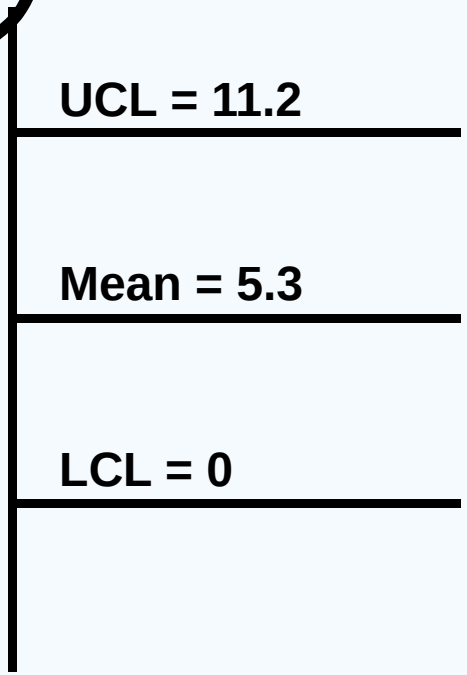
D_3 *and* D_4 = *control chart factors from Table S6.1*

Setting Control Limits

Average range $\bar{R}$ = 5.3 *pounds*
Sample size n = 5
From Table S6.1 $D_4 = 2.115$, $D_3 = 0$

$$UCL_R = D_4\bar{R}$$
$$= (2.115)(5.3)$$
$$= 11.2 \text{ pounds}$$

$$LCL_R = D_3\bar{R}$$
$$= (0)(5.3)$$
$$= 0 \text{ pounds}$$



Control Charts for Attributes

- ☑ *For variables that are categorical*
  - ☑ *Good/bad, yes/no, acceptable/unacceptable*
- ☑ *Measurement is typically counting defectives*
- ☑ *Charts may measure*
  - ☑ *Percent defective (p-chart)*
  - ☑ *Number of defects (c-chart)*

Control Limits for p-Charts

Population will be a binomial distribution, but applying the Central Limit Theorem allows us to assume a normal distribution for the sample statistics

$$UCL_p = \bar{p} + z\sigma_{\hat{p}}$$

$$LCL_p = \bar{p} - z\sigma_{\hat{p}}$$

$$\sigma_{\hat{p}} = \sqrt{\frac{\bar{p}(1 - \bar{p})}{n}}$$

where $\bar{p}$ = *mean fraction defective in the sample*

z = *number of standard deviations*

$\sigma_{\hat{p}}$ = *standard deviation of the sampling distribution*

n = *sample size*

p-Chart for Data Entry

Sample Number	Number of Errors	Fraction Defective	Sample Number	Number of Errors	Fraction Defective
1	6	.06	11	6	.06
2	5	.05	12	1	.01
3	0	.00	13	8	.08
4	1	.01	14	7	.07
5	4	.04	15	5	.05
6	2	.02	16	4	.04
7	5	.05	17	11	.11
8	3	.03	18	3	.03
9	3	.03	19	0	.00
10	2	.02	20	4	.04
				Total = 80	

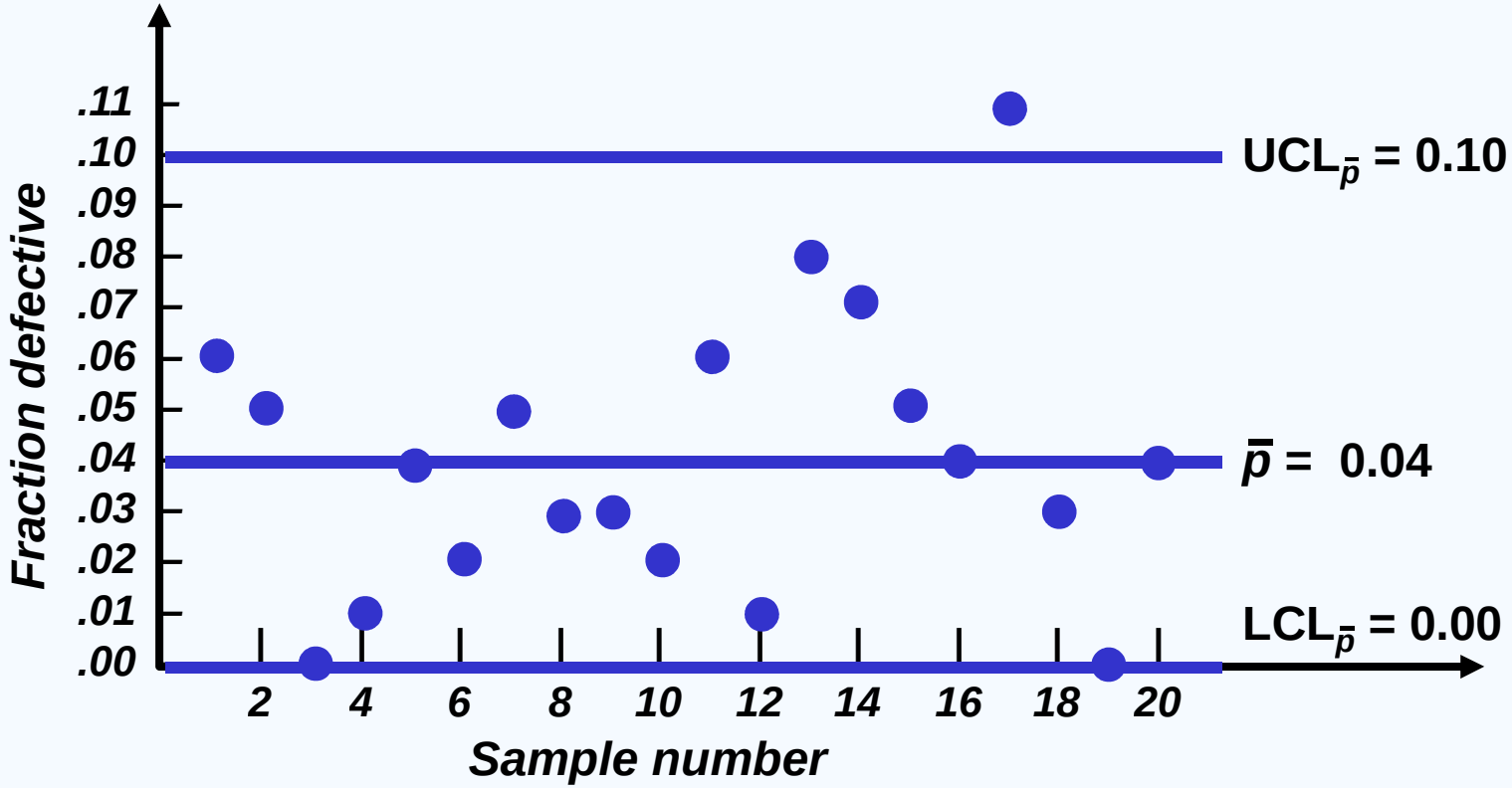
$$\bar{p} = \frac{80}{(100)(20)} = .04$$

$$\sigma_{\hat{p}} = \sqrt{\frac{(.04)(1 - .04)}{100}} = .02$$

p-Chart for Data Entry

$$UCL_p = \bar{p} + z\hat{\sigma}_{\hat{p}} = .04 + 3(.02) = .10$$

$$LCL_p = \bar{p} - z\hat{\sigma}_{\hat{p}} = .04 - 3(.02) = 0$$

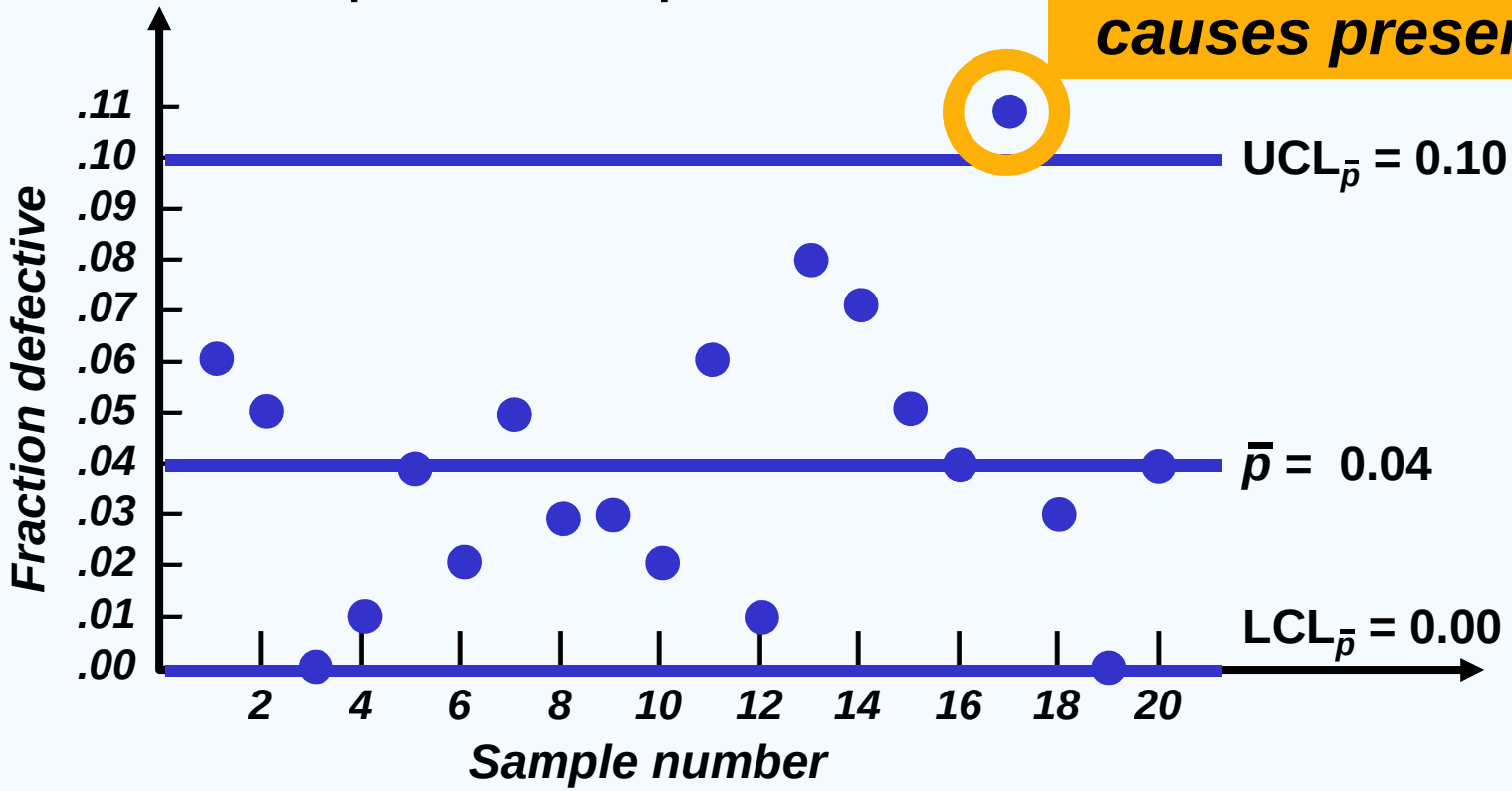


p-Chart for Data Entry

$$UCL_p = \bar{p} + z\sigma_{\hat{p}} = .04 + 3(.02) = .10$$

$$LCL_p = \bar{p} - z\sigma_{\hat{p}} = .04 - 3(.0$$

Possible assignable causes present



Control Limits for c-Charts

Population will be a Poisson distribution, but applying the Central Limit Theorem allows us to assume a normal distribution for the sample statistics

$$UCL_c = \bar{c} + 3\sqrt{\bar{c}} \qquad LCL_c = \bar{c} - 3\sqrt{\bar{c}}$$

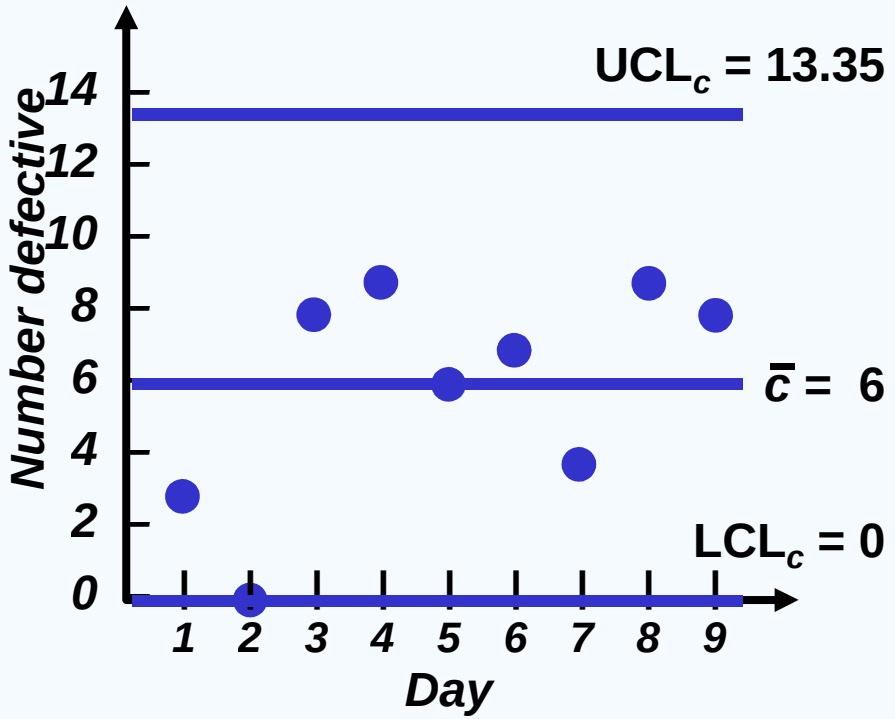
where $\bar{c}$ = ***mean number defective in the sample***

c-Chart for Cab Company

$\bar{c}$ = 54 *complaints*/9 *days* = 6 *complaints*/*day*

$$UCL_c = \bar{c} + 3\sqrt{\bar{c}}$$
$$= 6 + 3\sqrt{6}$$
$$= 13.35$$

$$LCL_c = \bar{c} - 3\sqrt{\bar{c}}$$
$$= 3 - 3\sqrt{6}$$
$$= 0$$



Which Control Chart to Use

Variables Data

- ☑ Using an $\bar{x}$-chart and R-chart:
  - ☑ Observations are variables
  - ☑ Collect 20 - 25 samples of $n = 4$, or $n = 5$, or more, each from a stable process and compute the mean for the $\bar{x}$-chart and range for the R-chart
  - ☑ Track samples of n observations each

Which Control Chart to Use

Attribute Data

- ☑ Using the p-chart:
  - ☑ Observations are attributes that can be categorized in two states
  - ☑ We deal with fraction, proportion, or percent defectives
  - ☑ Have several samples, each with many observations

Which Control Chart to Use

Attribute Data

- ☑ *Using a c-Chart:*
  - ☑ *Observations are attributes whose defects per unit of output can be counted*
  - ☑ *The number counted is often a small part of the possible occurrences*
  - ☑ *Defects such as number of blemishes on a desk, number of typos in a page of text, flaws in a bolt of cloth*

Strategic Importance of Maintenance and Reliability

- ☑ *Failure has far reaching effects on a firm's*
  - ☑ *Operation*
  - ☑ *Reputation*
  - ☑ *Profitability*
  - ☑ *Dissatisfied customers*
  - ☑ *Idle employees*
  - ☑ *Profits becoming losses*
  - ☑ *Reduced value of investment in plant and equipment*

Maintenance and Reliability

- ***The objective of maintenance and reliability is to maintain the capability of the system while controlling costs***
  - ***Maintenance is all activities involved in keeping a system's equipment in working order***
  - ***Reliability is the probability that a machine will function properly for a specified time***

Important Tactics

- ☑ ***Reliability***
  1. *Improving individual components*
  2. *Providing redundancy*
- ☑ ***Maintenance***
  1. *Implementing or improving preventive maintenance*
  2. *Increasing repair capability or speed*

Strategy and Results

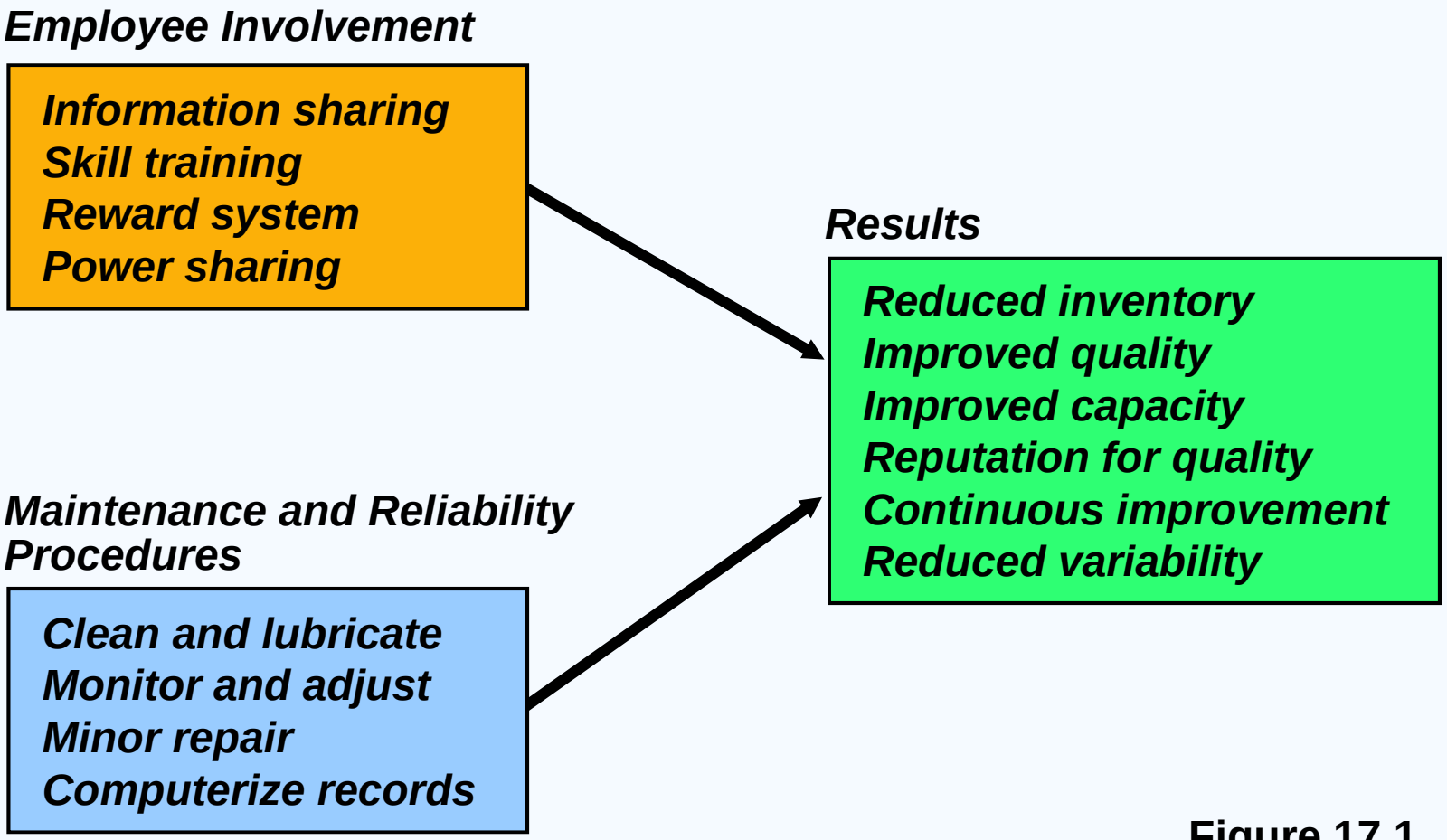


Figure 17.1

Maintenance

- ***Two types of maintenance***
  - ***Preventive maintenance – routine inspection and servicing to keep facilities in good repair***
  - ***Breakdown maintenance – emergency or priority repairs on failed equipment***

Implementing Preventive Maintenance

- ☑ ***Need to know when a system requires service or is likely to fail***
- ☑ ***High initial failure rates are known as infant mortality***
- ☑ ***Once a product settles in, MTBF generally follows a normal distribution***
- ☑ ***Good reporting and record keeping can aid the decision on when preventive maintenance should be performed***

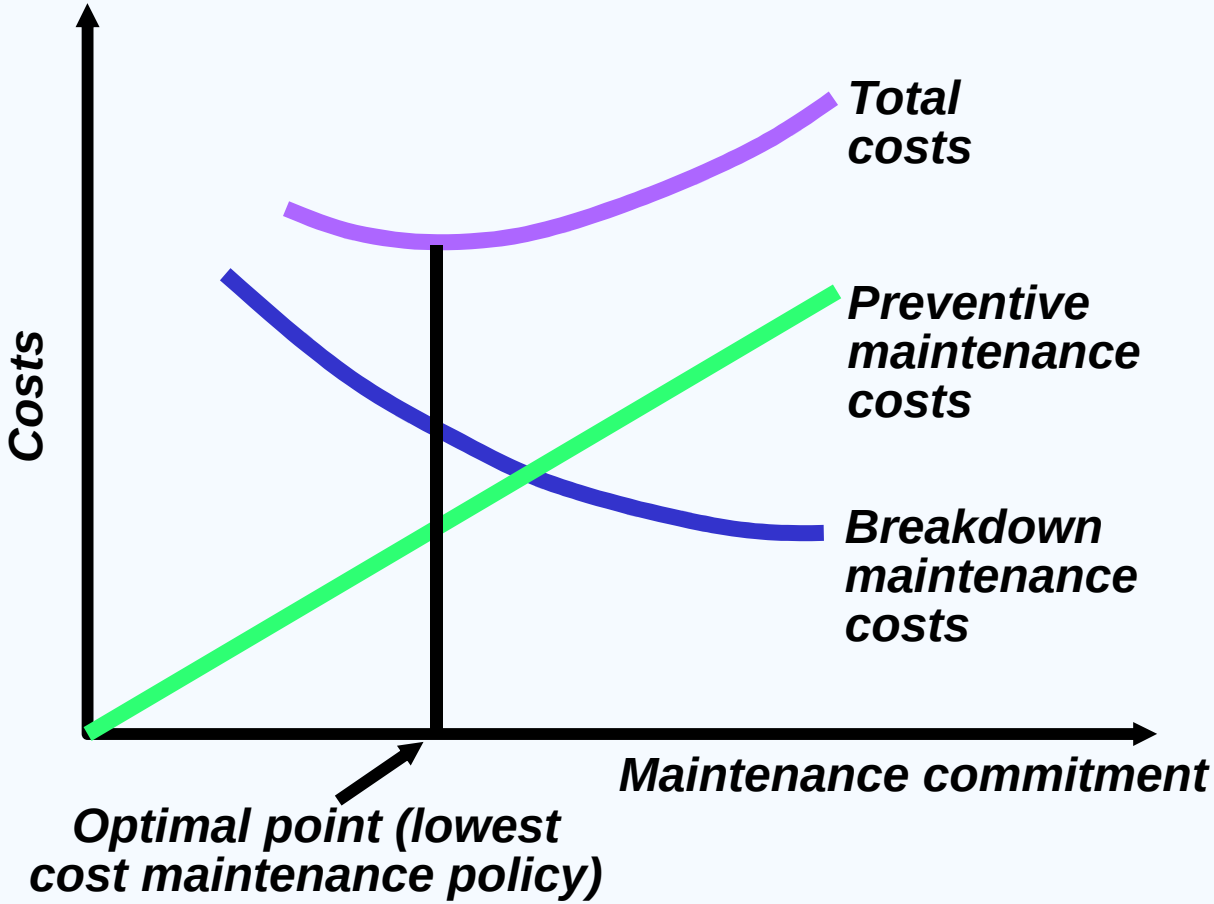
Titik Berat Pemeliharaan Preventif

- ***Feel***
- ***Inspection***
- ***Clear***
- ***Adjusment***
- ***Lubrication***

Maintenance Costs

- ☑ *The traditional view attempted to balance preventive and breakdown maintenance costs*
- ☑ *Typically this approach failed to consider the true total cost of breakdowns*
  - ☑ *Inventory*
  - ☑ *Employee morale*
  - ☑ *Schedule unreliability*

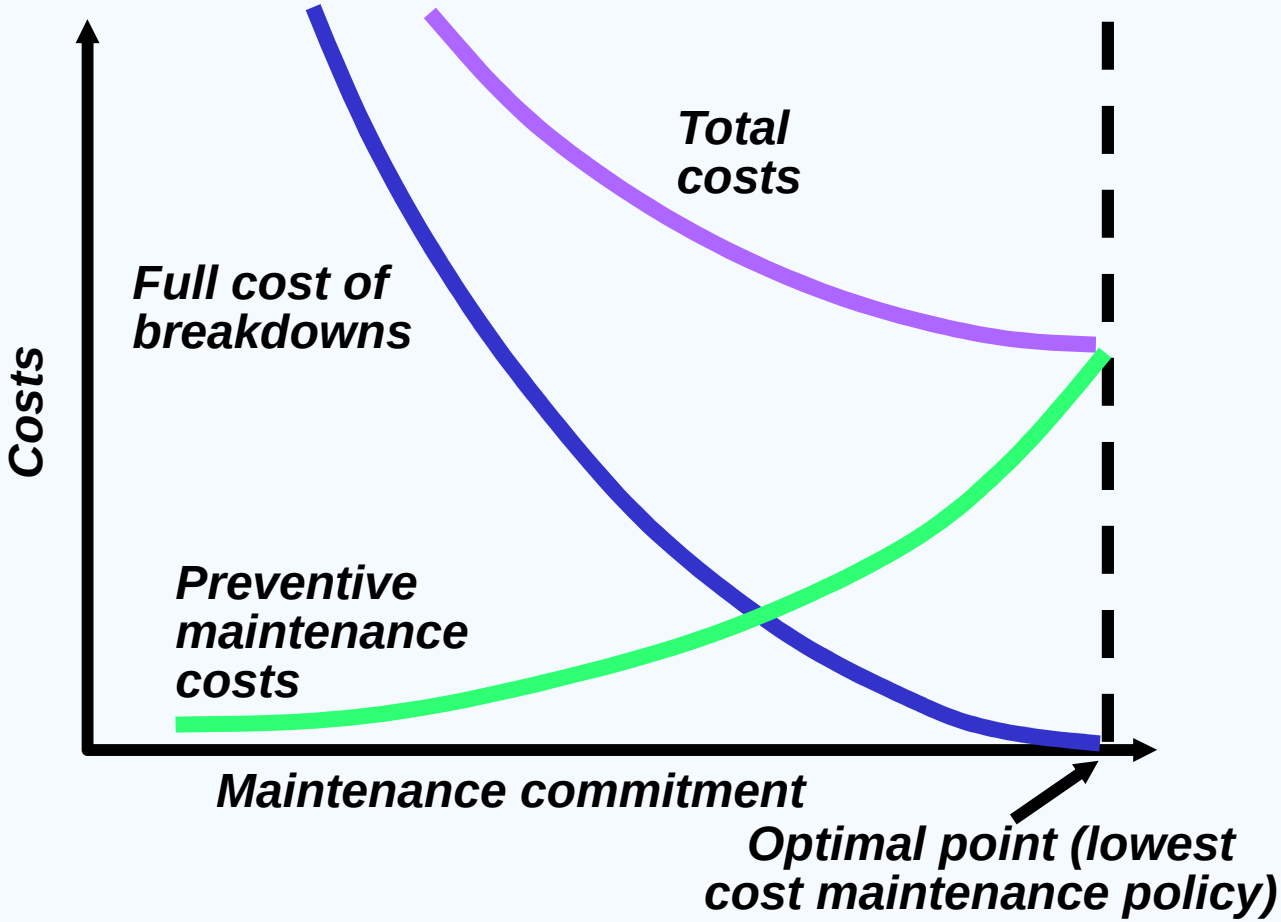
Maintenance Costs



Traditional View

Figure 17.4 (a)

Maintenance Costs



Full Cost View

Figure 17.4 (b)

Increasing Repair Capabilities

1. Well-trained personnel
2. Adequate resources
3. Ability to establish repair plan and priorities
4. Ability and authority to do material planning
5. Ability to identify the cause of breakdowns
6. Ability to design ways to extend MTBF

How Maintenance is Performed

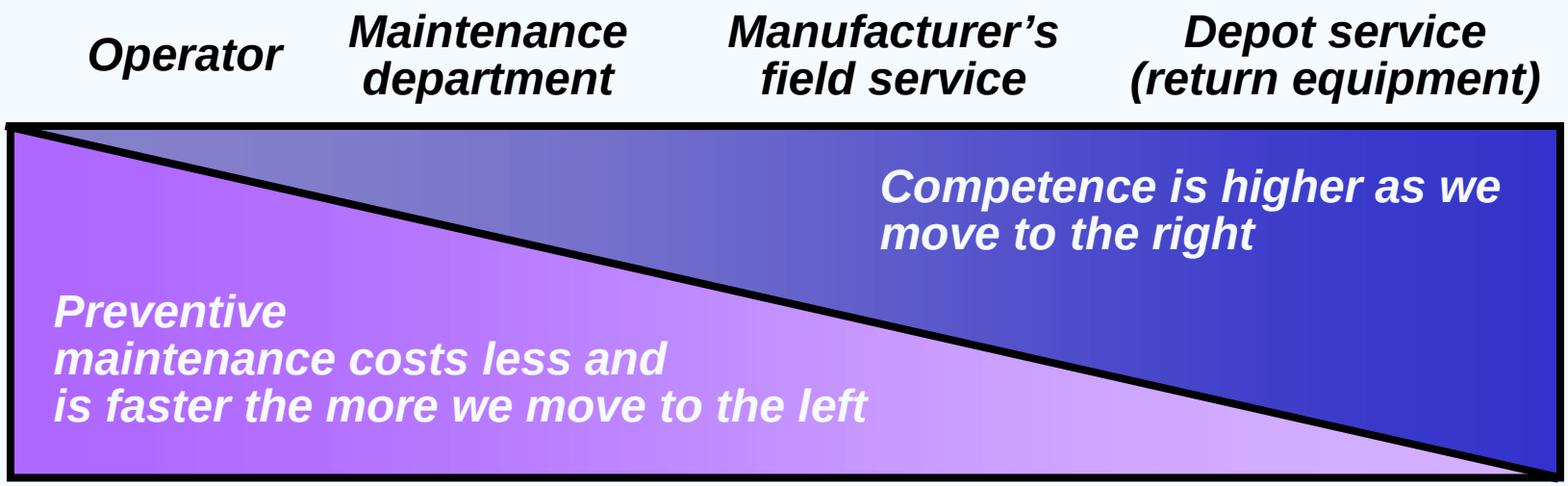


Figure 17.5