Understanding Mechanical Design

Chapter 2

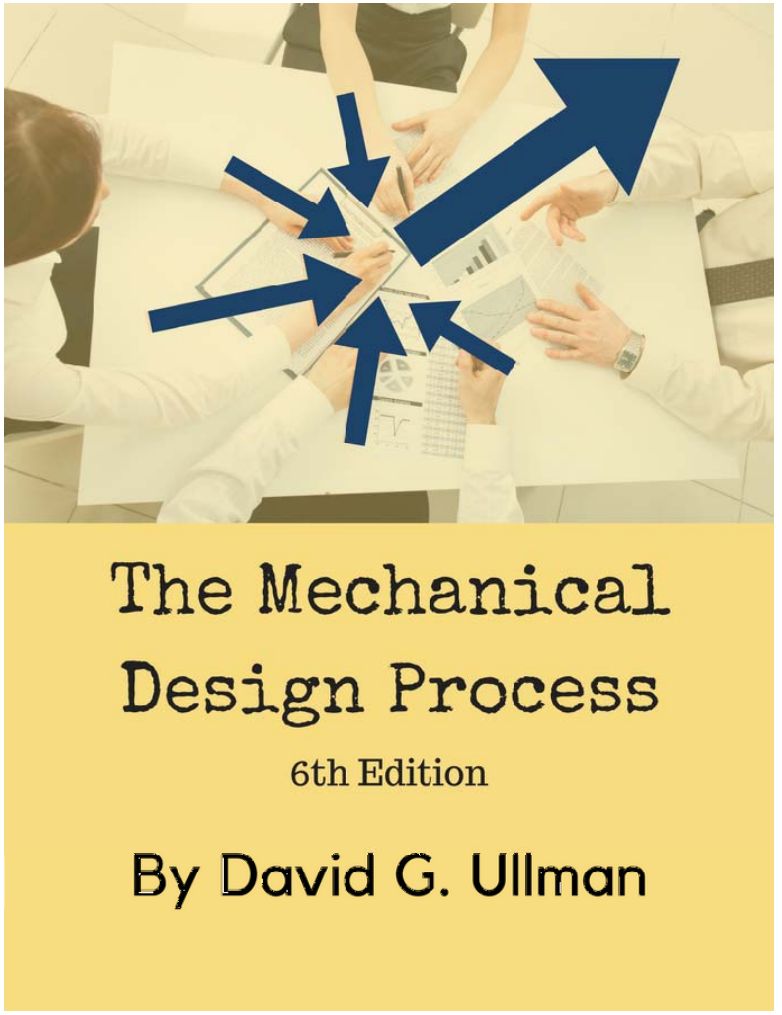
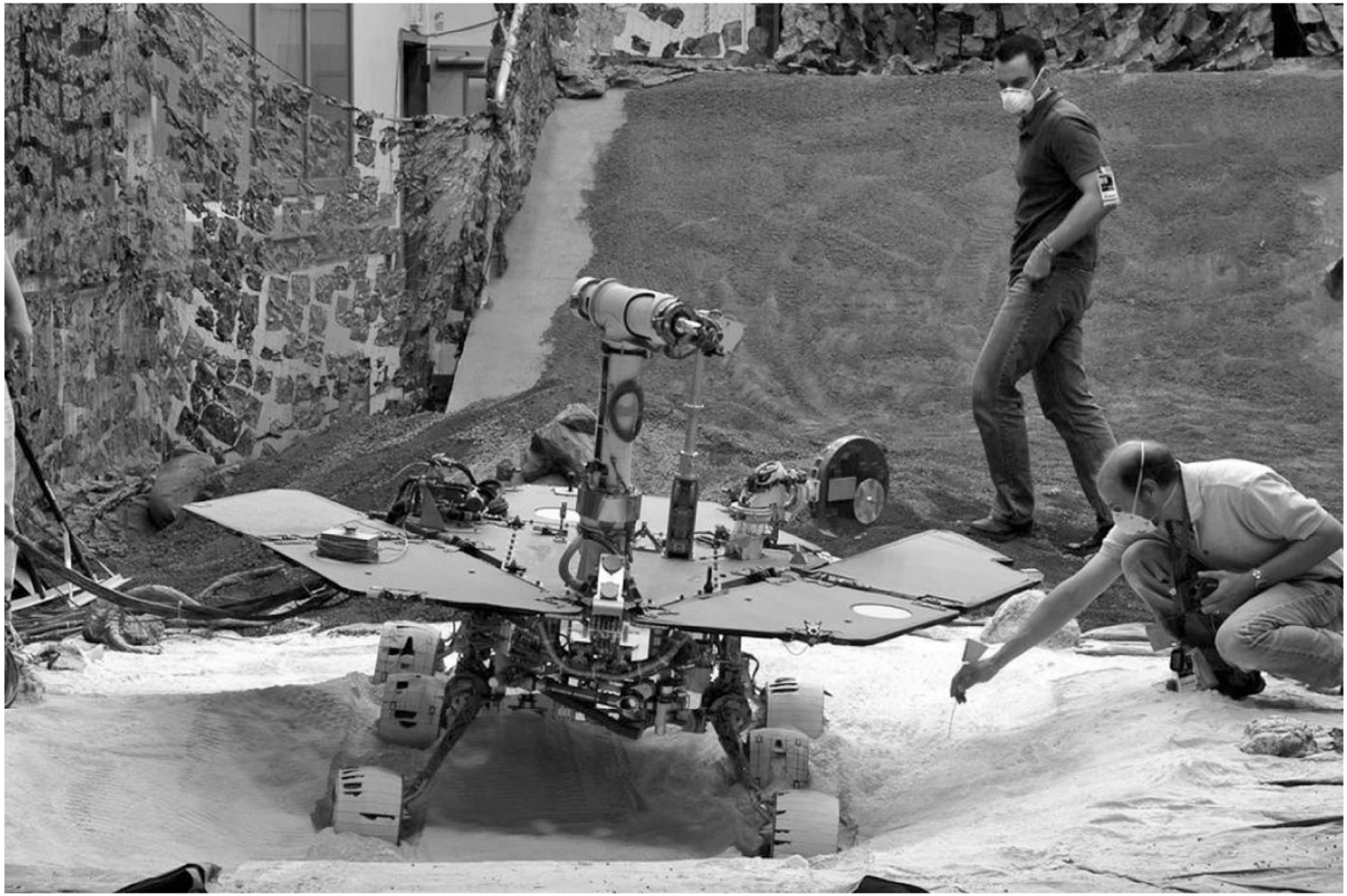


Figure 2.1

Irwin Industrial Tools

Figure 2.2



JPL/NASA

Figure 2.3

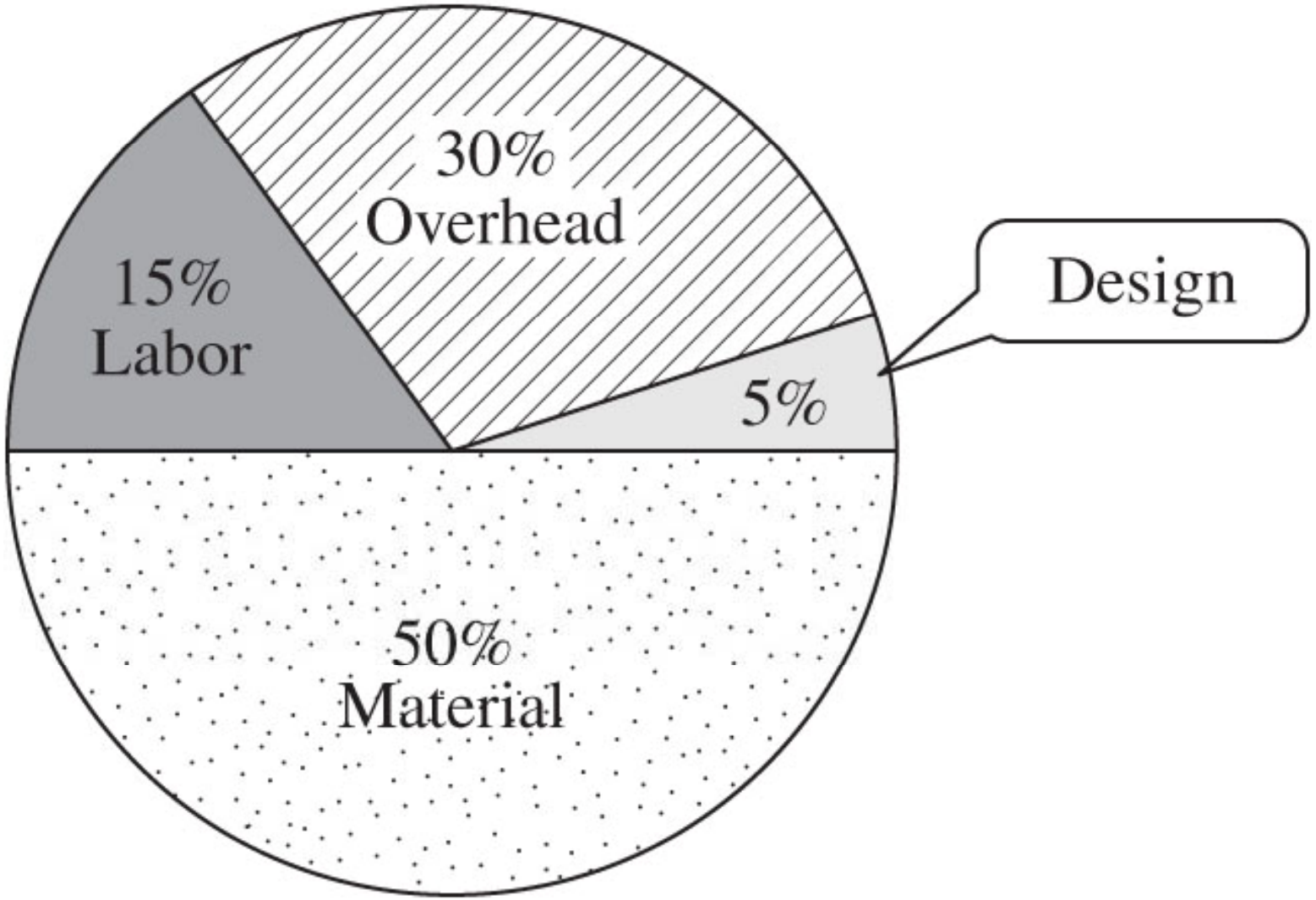


Figure 2.4

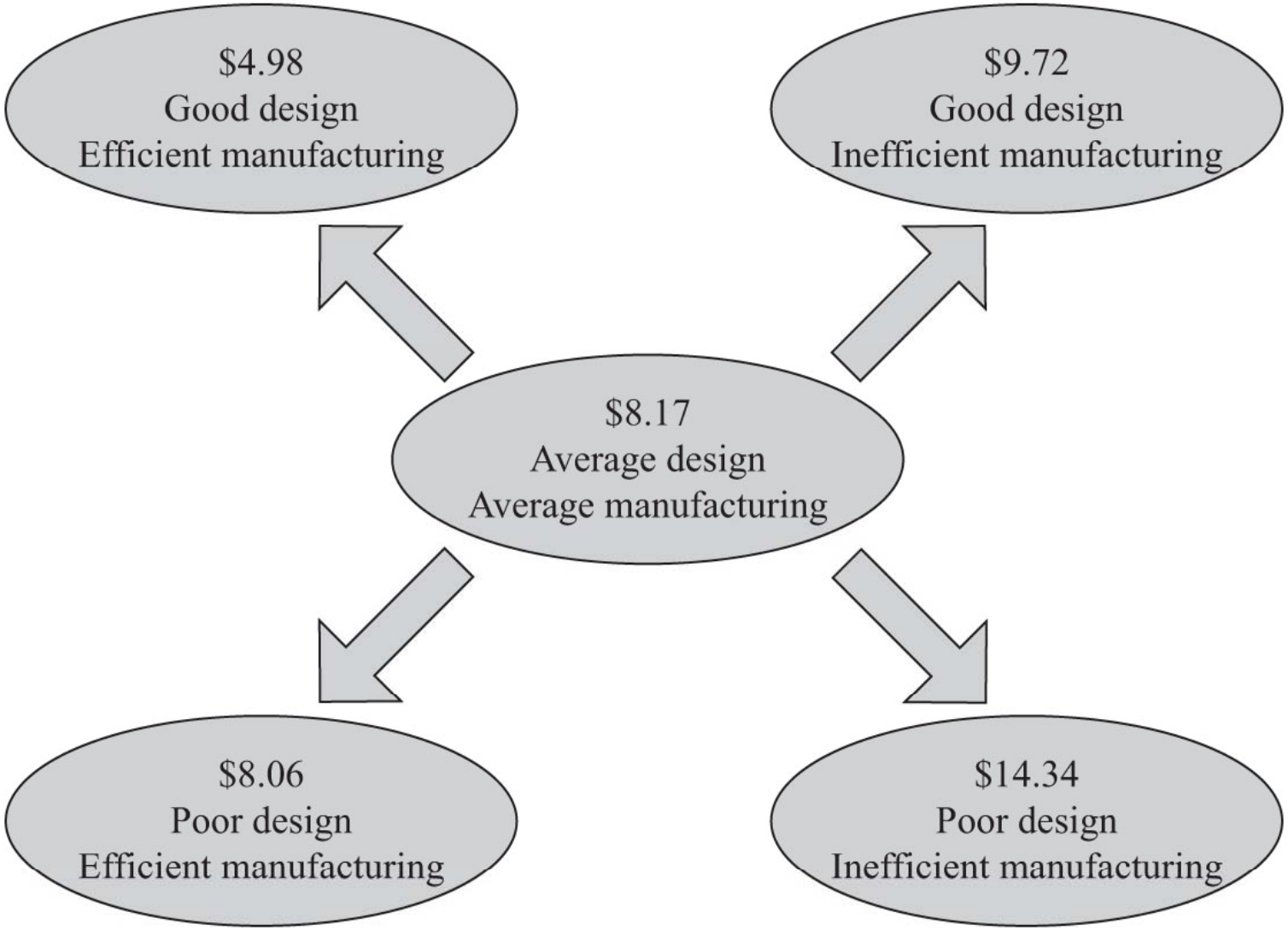


Figure 2.5

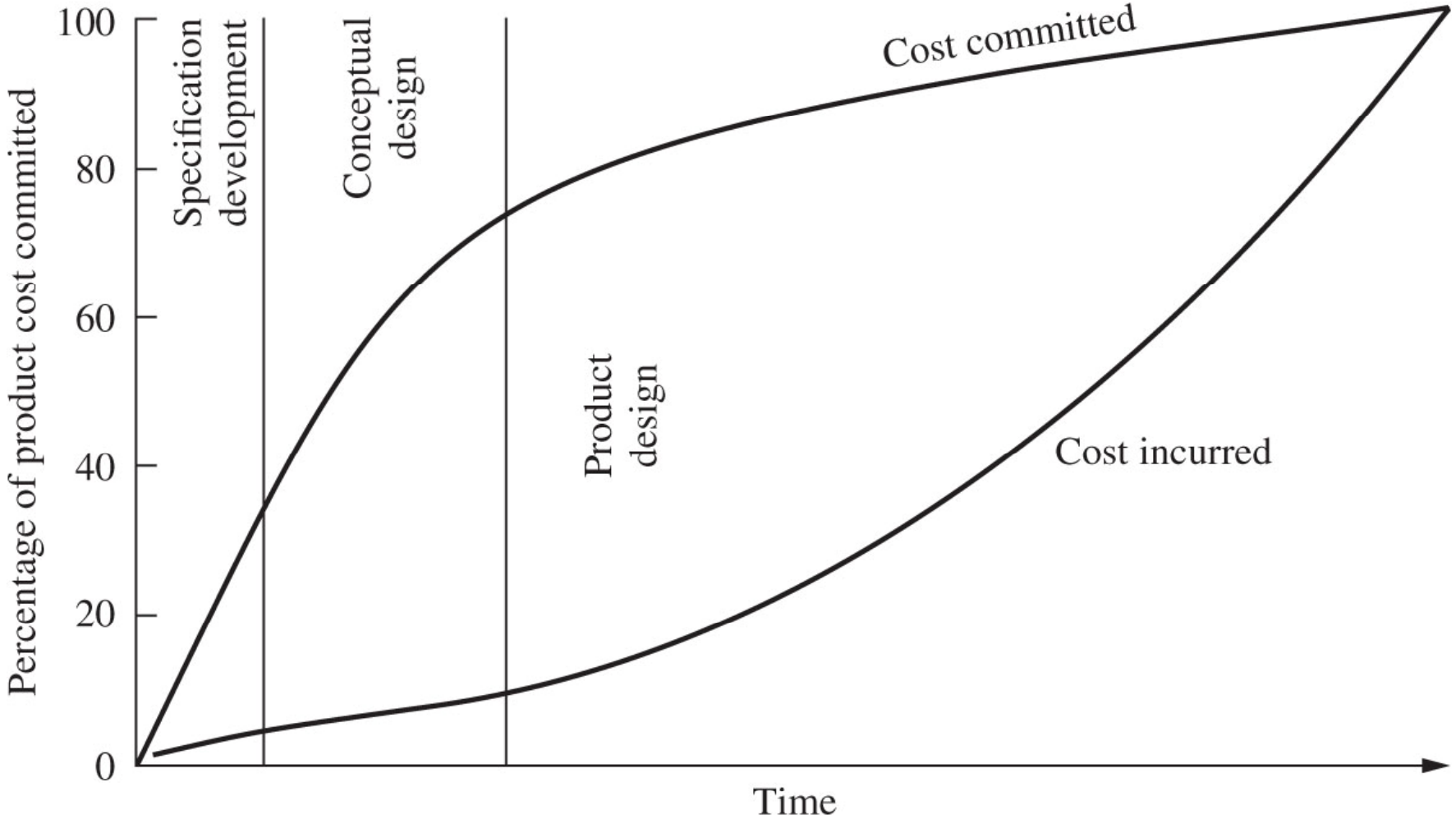


Table 2.1 What determines quality

	1989	2002
Works as it should	4.99 (1)	4.58 (1)
Lasts a long time	4.75 (2)	3.93 (5)
Is easy to maintain	4.65 (3)	3.29 (5)
Looks attractive	2.95 (4–5)	3.58 (3–4)
Incorporates latest technology/features	2.95 (4–5)	3.58 (3–4)

Scale: 5 = very important, 1 = not important at all, brackets denote rank.
Sources: Based on a survey of consumers published in *Time,* Nov. 13, 1989, and a survey based on quality professional, R. Sebastianelli and N. Tamimi, "How Product Quality Dimensions Relate to Defining Quality," *International Journal of Quality and Reliability Management,* Vol. 19, No. 4, pp. 442–453, 2002.

Figure 2.6

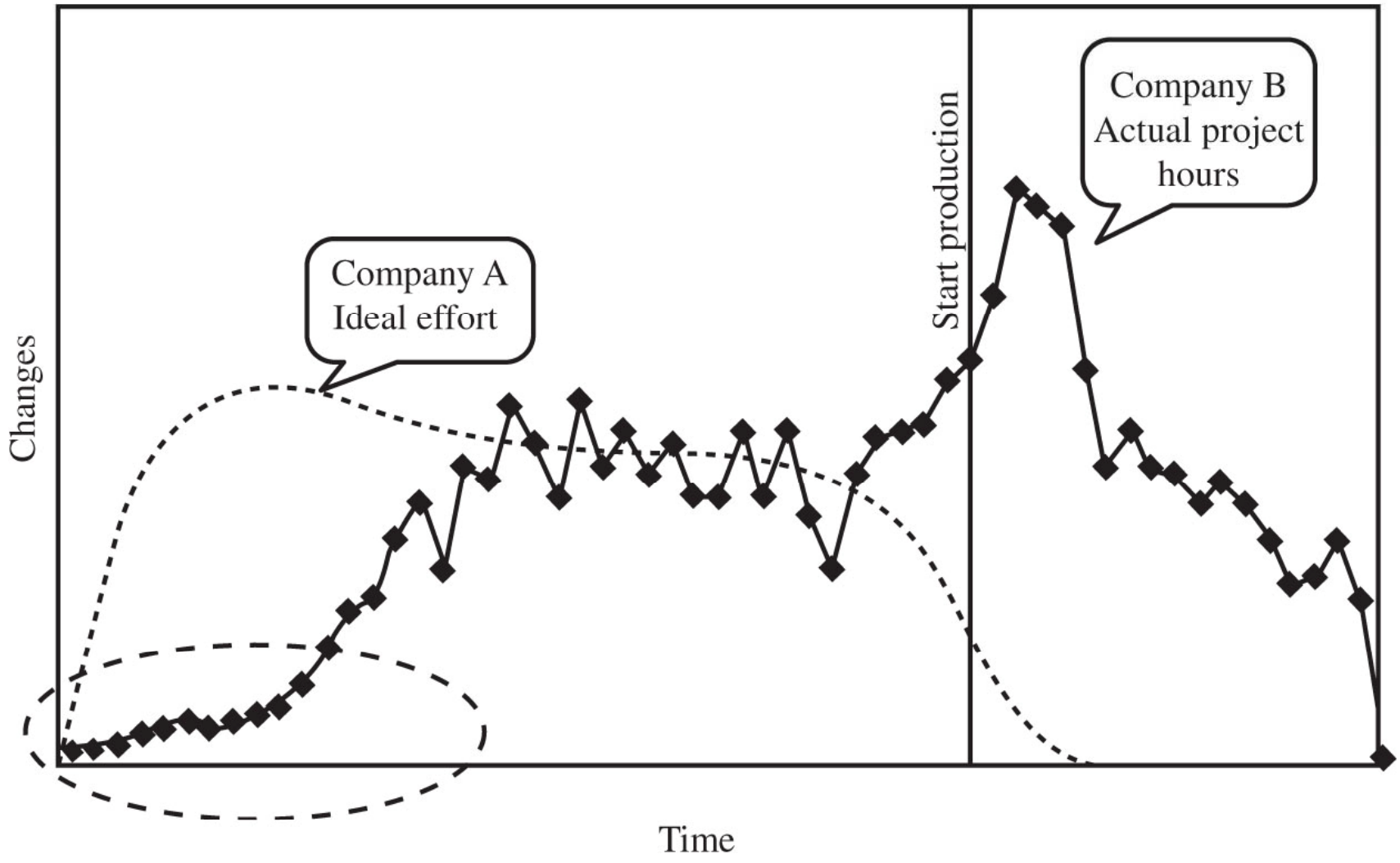


Figure 2.7

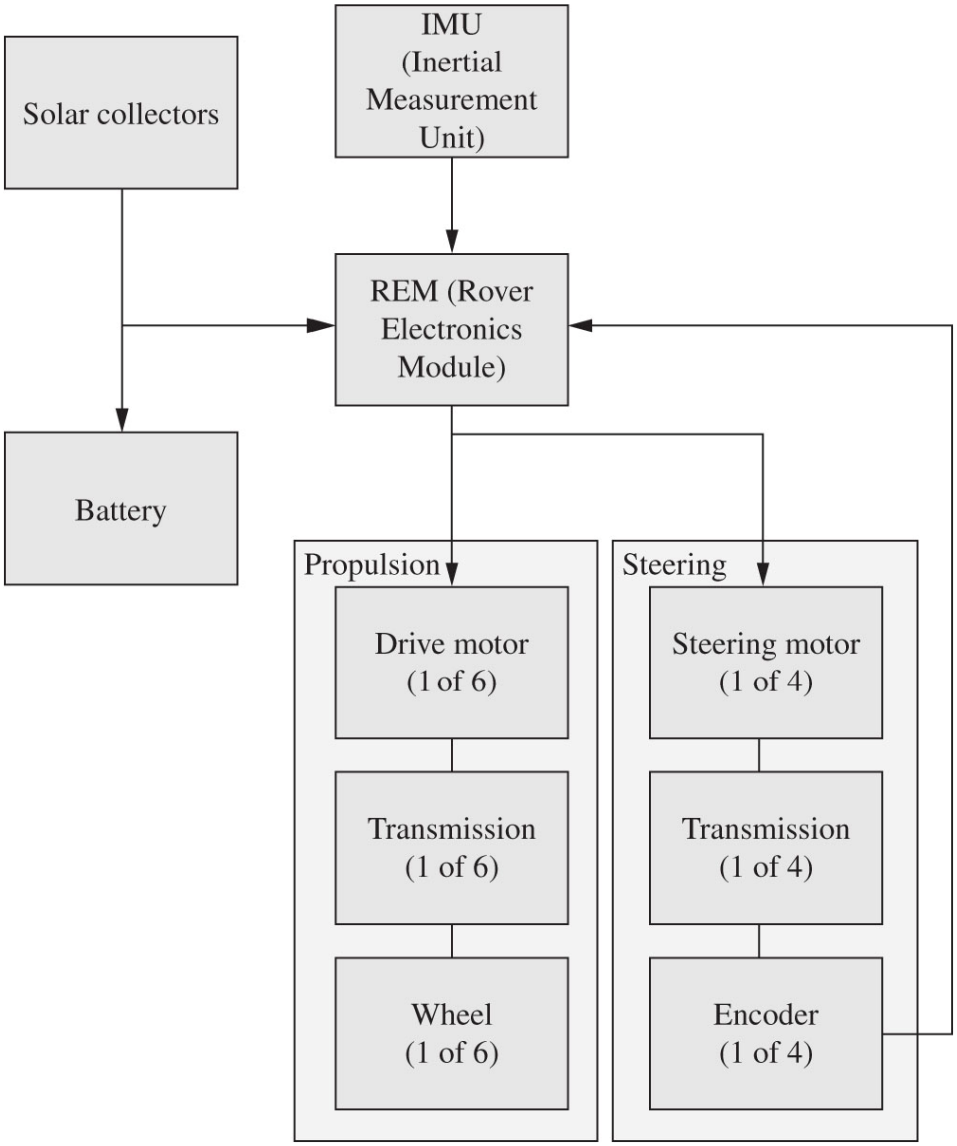


Figure 2.8

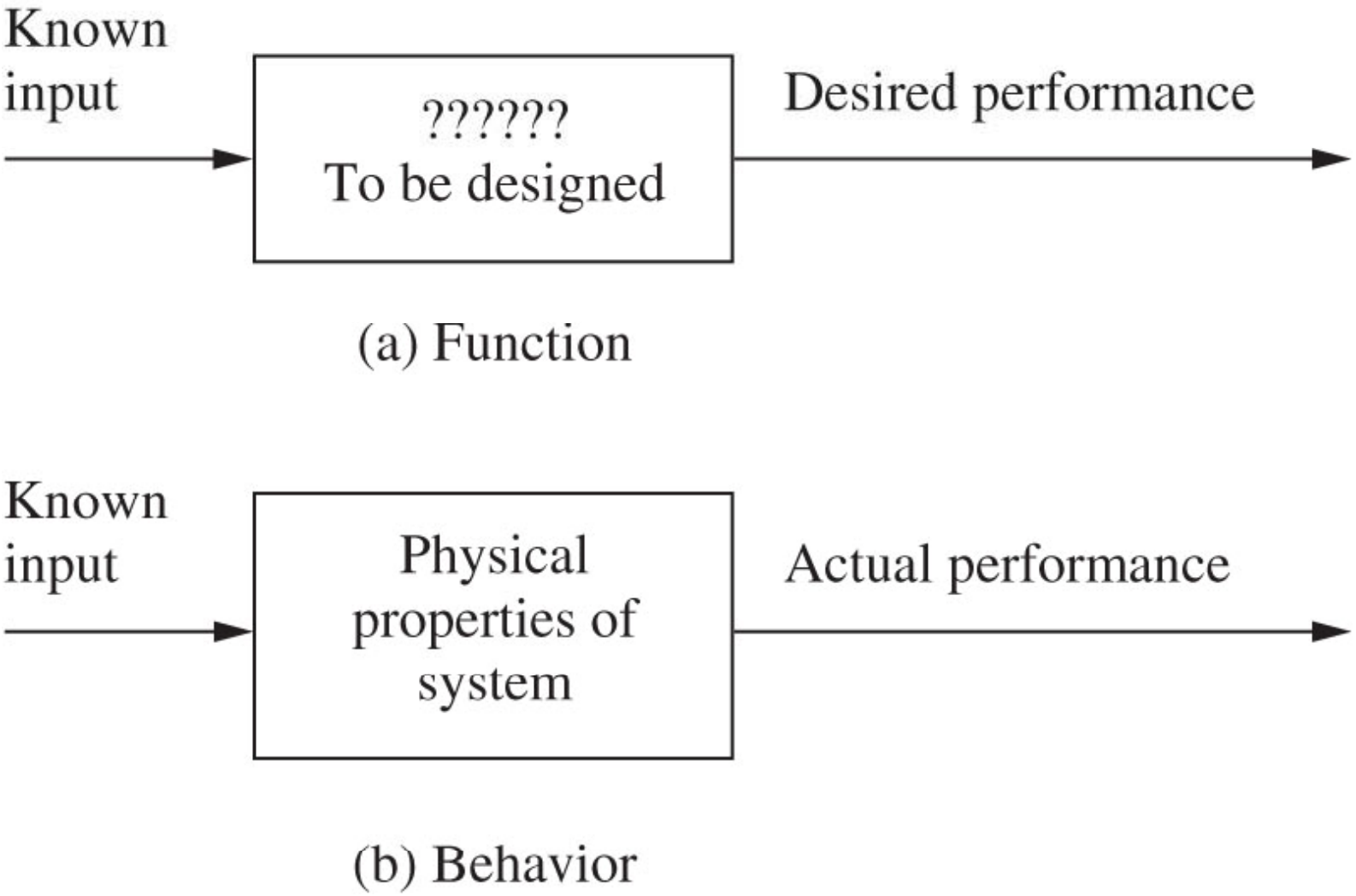
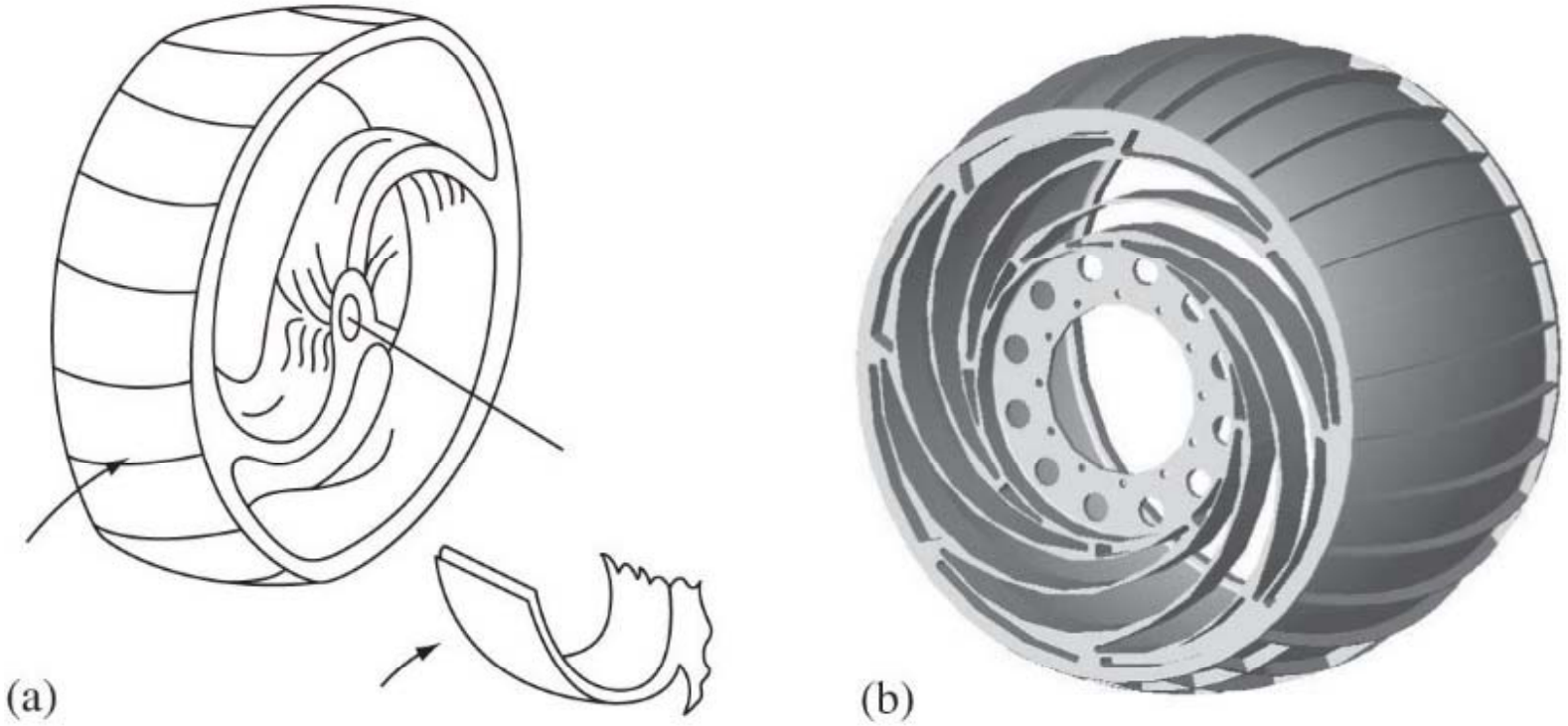


Figure 2.9



David Ullman

Table 2.2 Levels of abstraction in different languages with bolt example

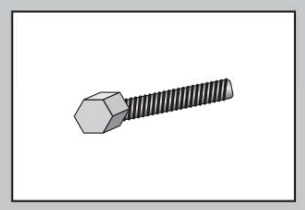
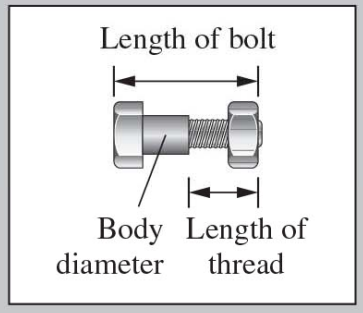
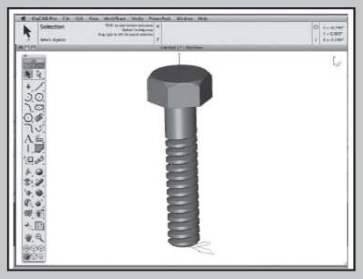
		Levels of Abstraction	
Language	Abstract ⟷		Concrete
Semantic	Casual words "a bolt"	Reference to specific parameters or components "a short, coarse bolt"	Reference to the values of the specific parameters or components 1/4-20 UNC Grade 5 bolt
Graphical	Rough sketch 	Scale drawings 	Solid models 
Analytical	Qualitative relations "right hand rule"	Back-of-the-envelope calculations	Detailed analysis $\tau = F/A$
Physical	NA	Models of the product	Final hardware 

Figure 2.10

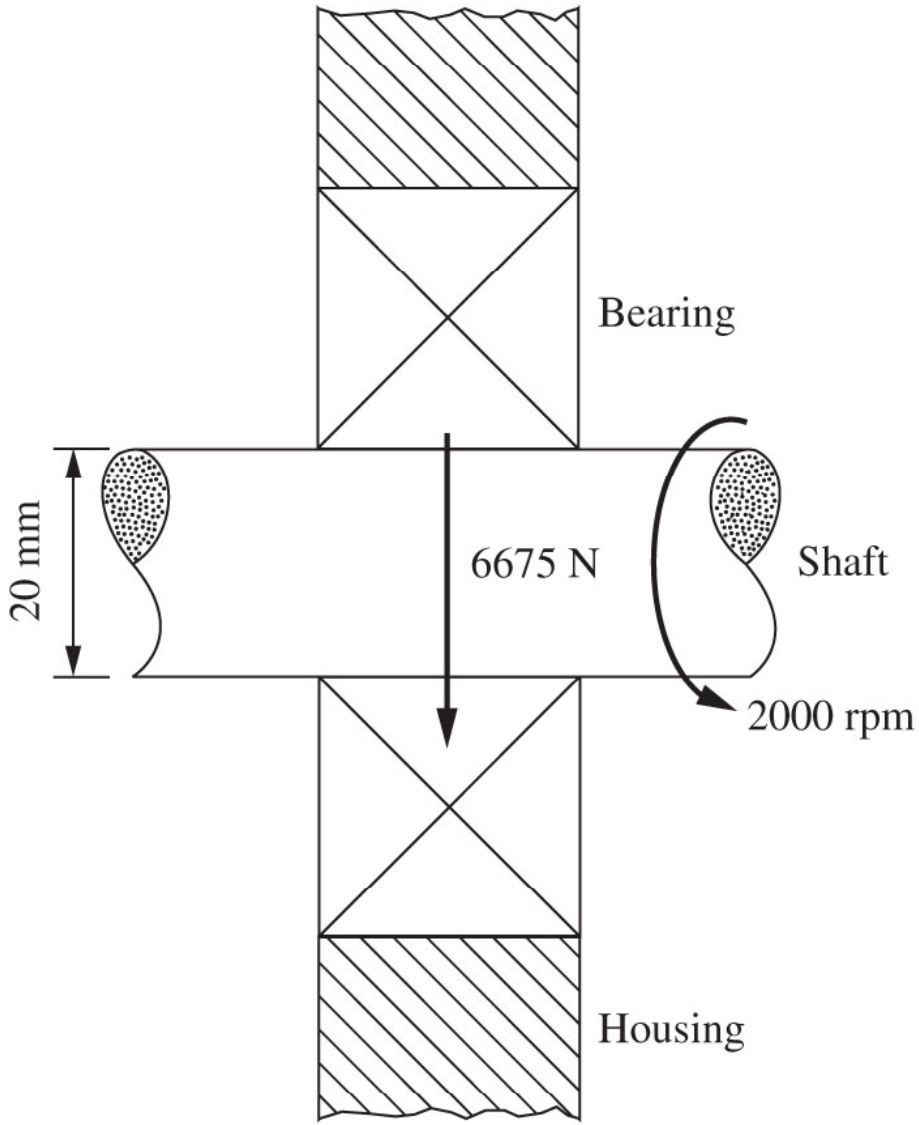


Table 2.3 Potential bearings for a shaft

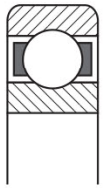
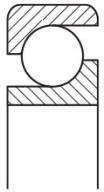
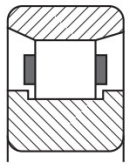
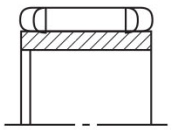
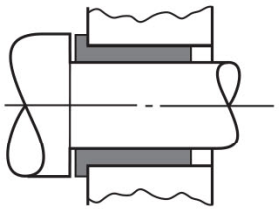
Type		Outside diameter (mm)	Width (mm)	Load rating (lb)	Speed limit (rpm)	Catalog number
Deep-groove ball bearing		42	8	1560	18,000	6000
		47	14	2900	15,000	6204
		52	15	3900	9000	6304
Angular-contact ball bearing		47	14	3000	13,000	7204
		37	9	1960	34,000	71,904
Roller bearing		47	14	6200	13,000	204
		52	15	7350	13,000	220
Needle bearing		24	20	1930	13,000	206
		26	12	2800	13,000	208
Nylon bushing		23	Variable	290 ⋮ 8	10 ⋮ 500	4930

Figure 2.11

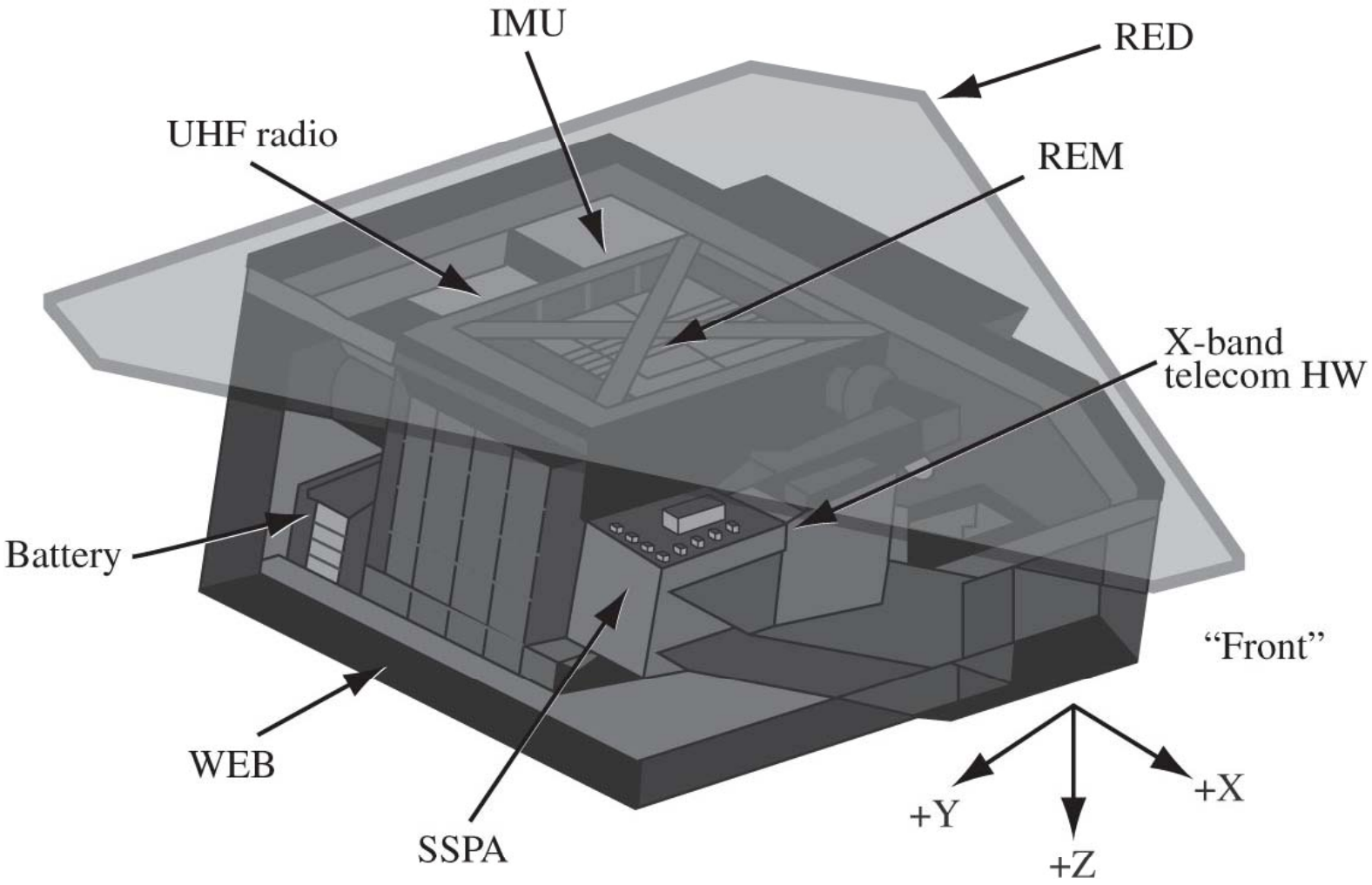


Figure 2.12

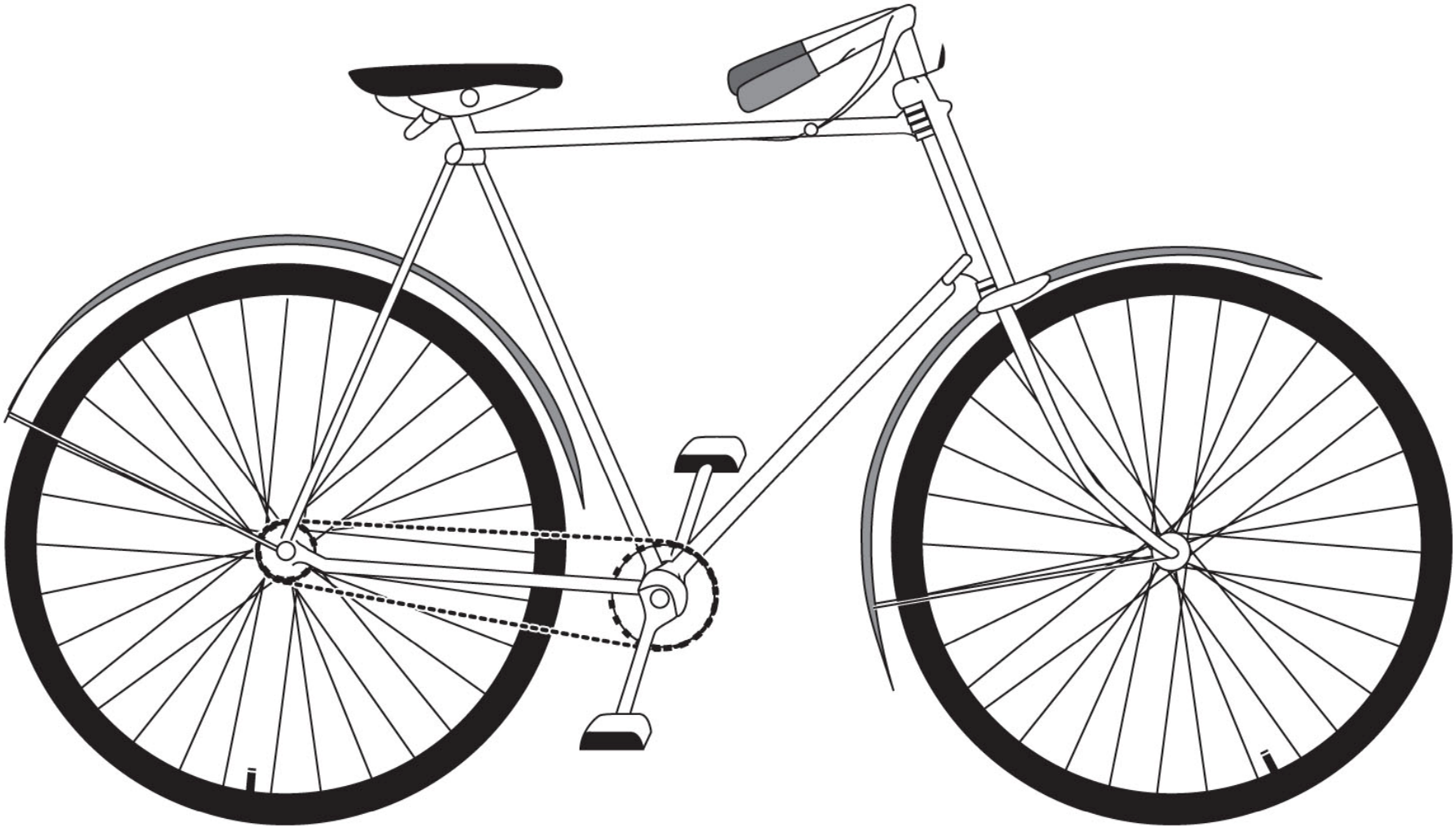


Figure 2.13

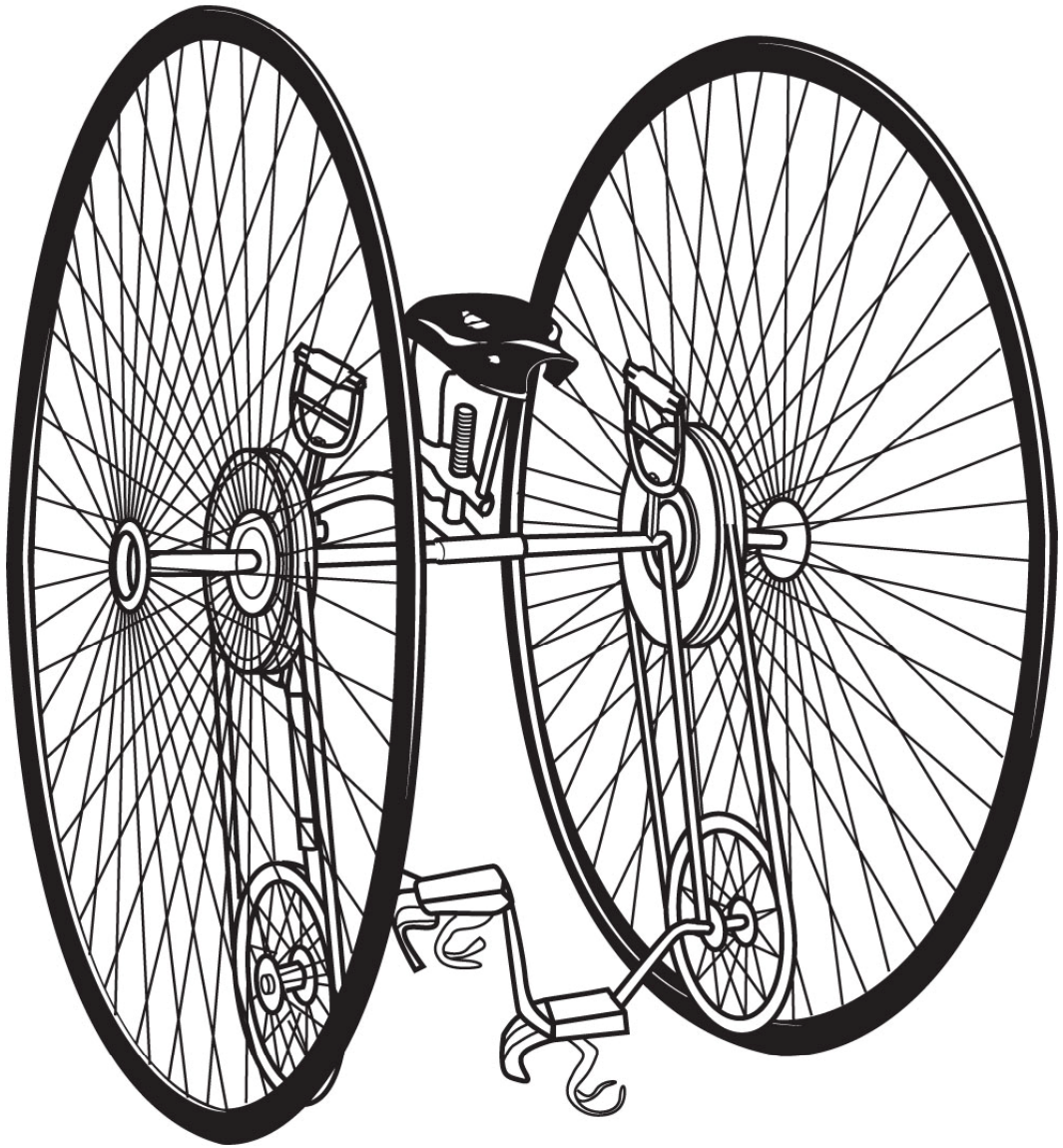


Figure 2.14

Marin Bicycles

Figure 2.15

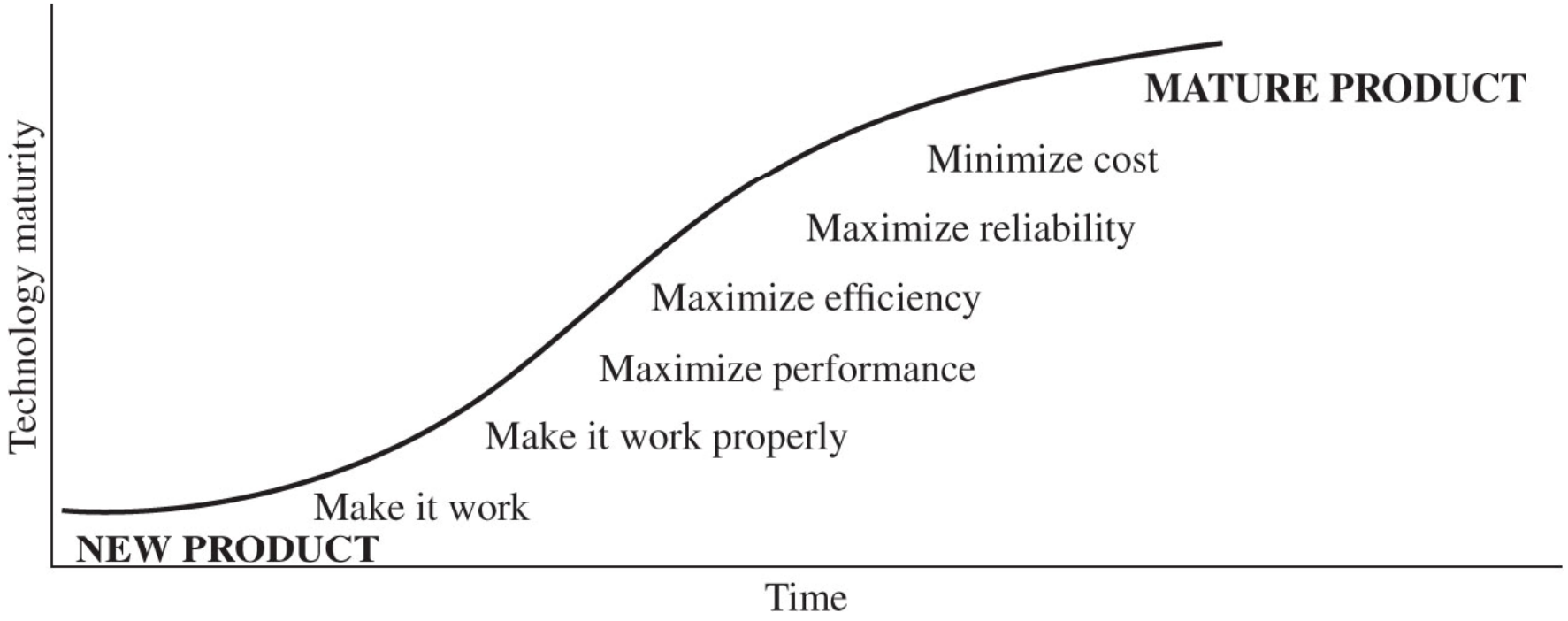


Figure 2.16

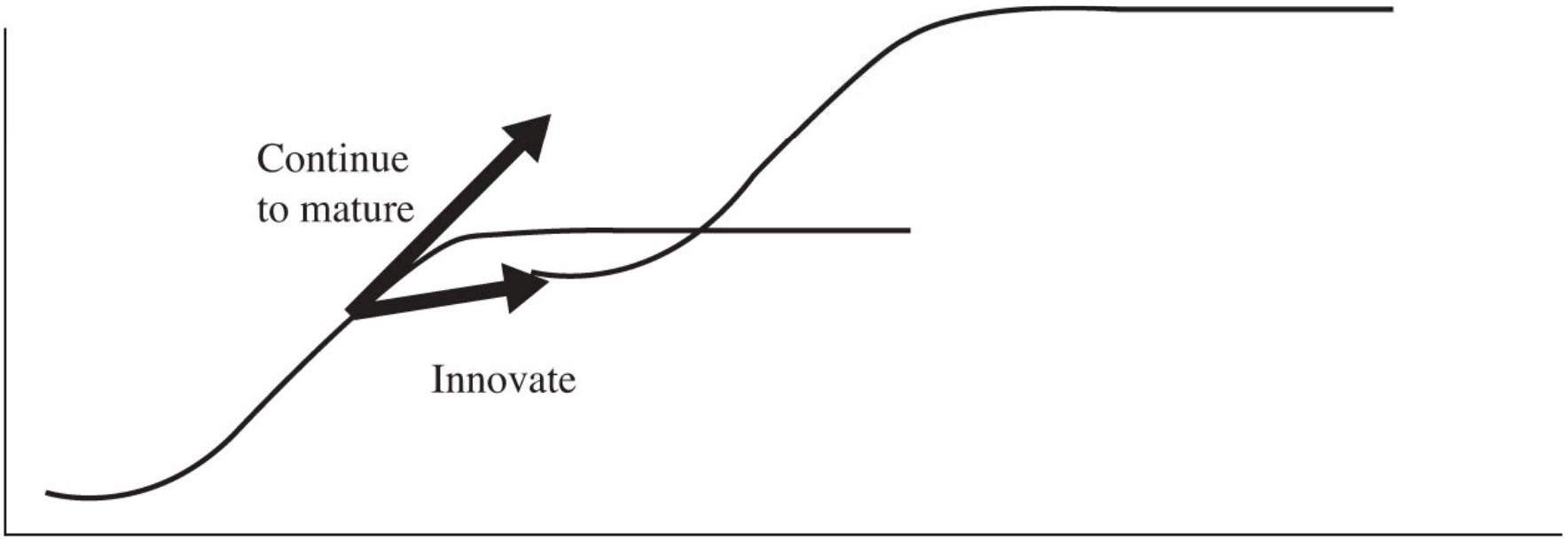


Figure 2.17a

Design Organization: Example for the Mechanical Design Process | **Date:** Aug. 14, 2007

Product Decomposed: Irwin Quick Grip—pre 2007

Description: This is the Quick-Grip Product that has been on the market for many years

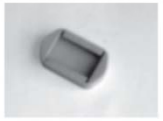
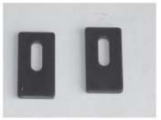
How it works: Squeeze the pistol grip repeatedly to move the jaws closer together and increase the clamping force. Squeeze the release trigger to release the clamping force. The foot (the part on the left in the picture that holds the face that is clamped against) is reversible so the clamping force can be made to push apart rather than squeeze together.

Parts:

Part #	Part Name	# Req'd.	Material	Mfg. Process	Image
1	Main body	1	PPO or PVC	Injection molded	
2	Trigger	1	PVC	Injection molded	
4	Face plate, left	1	Polyethylene	Injection molded	

Irwin Industrial Tools

Figure 2.17b

Part #	Part Name	# Req'd.	Material	Mfg. Process	Image
8	Pad	2	??	Injection molded	
13	Power spring	1	Steel	Wound wire	
14	Jam plates	2	Steel	Stamped sheet	

Disassembly:

Step #	Procedure	Part #s removed	Image
1	Take off left face plate	4	
12	Remove jam plates and power spring from main body assembly	13, 14, 1	
13	Remove trigger from main body assembly	2	
14	Pry off pad from main body assembly	8	

The Mechanical Design Process Designed by Professor David G. Ullman
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Irwin Industrial Tools