Case Study 1.2: Wheelchair Design as a Multidisciplinary Endeavor
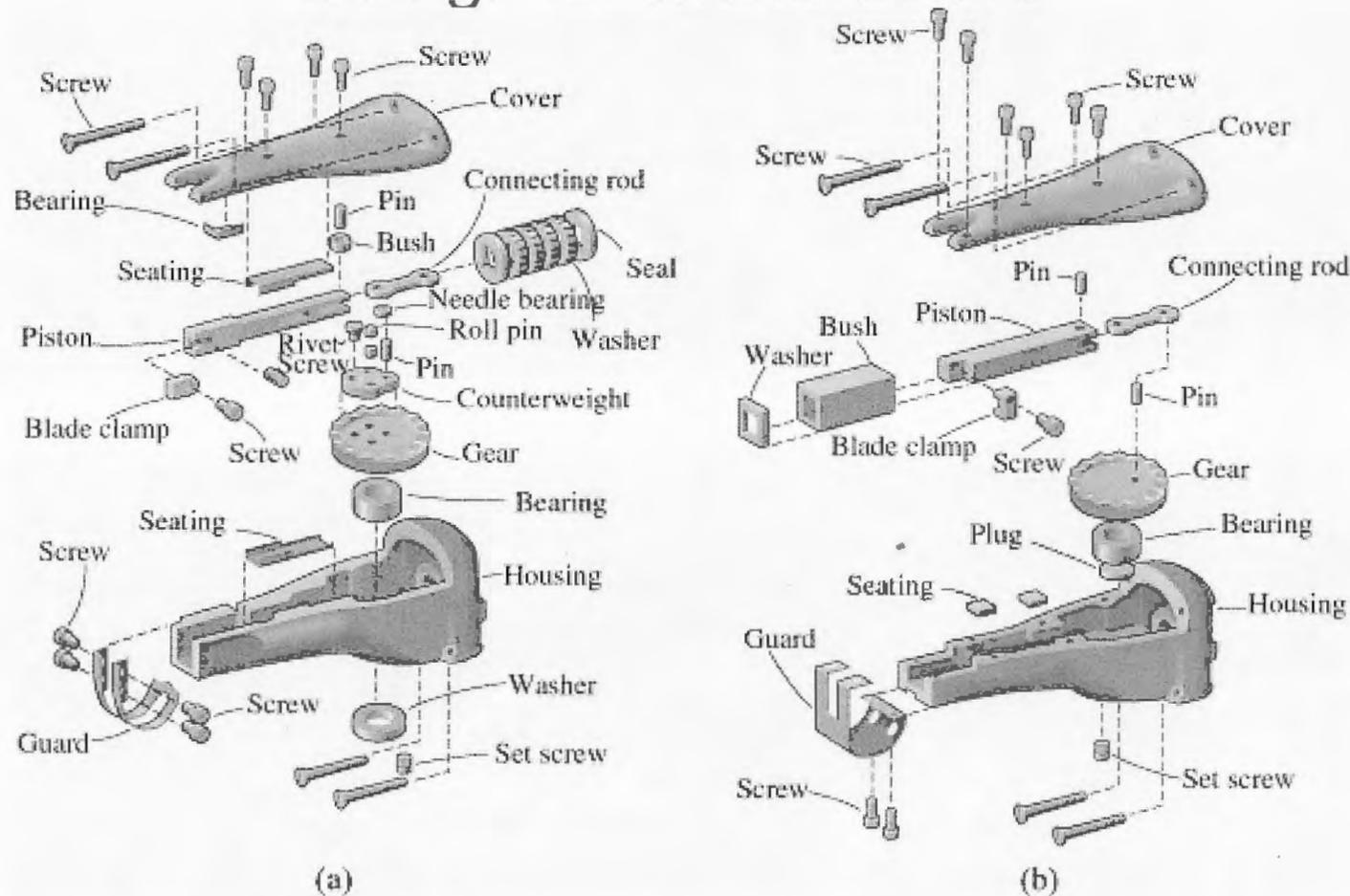

Wheelchair, courtesy of Sunrise Medical Equipment Co.
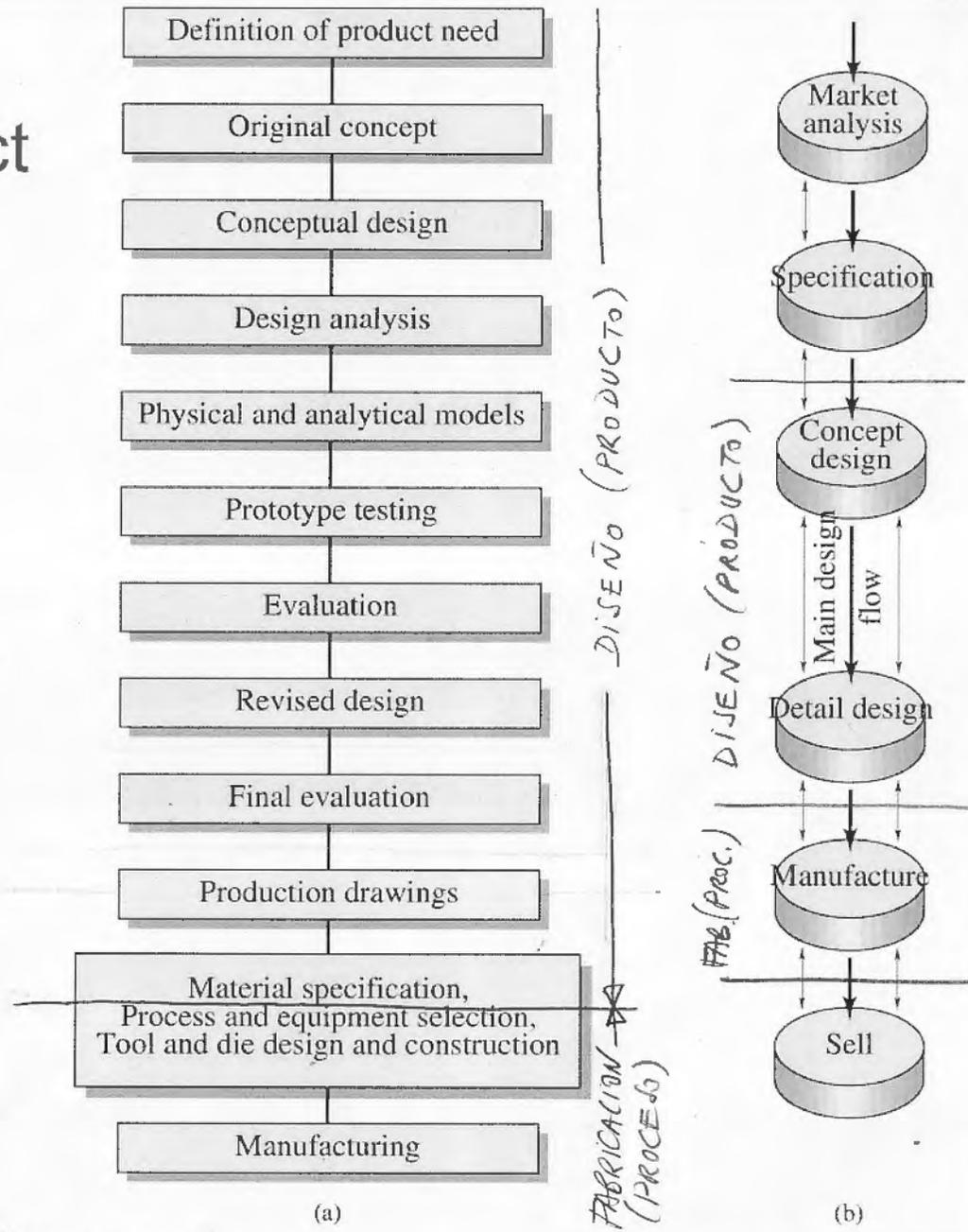
Hamrock, Jacobson and Schmid

Design for Manufacture

(a)

(b)

Effect of <u>manufacturing and assembly</u> on design of reciprocating power saw.
(a) Original design, with 41 parts and 6.37 min assembly time. (b) modified design, with 29 parts and 2.58 min assembly time. [From Boothroyd (1992)].

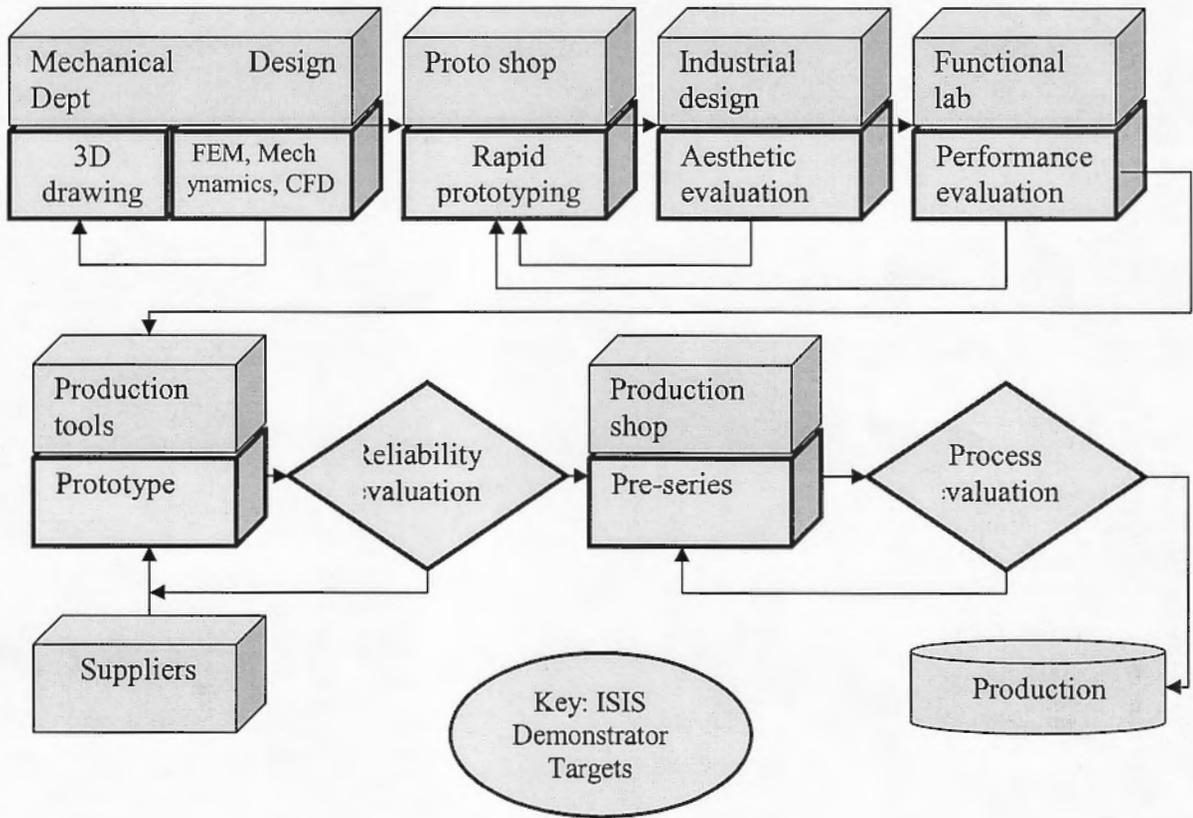Text Reference: Figure 1.2, page 14

Approaches to Product Development

- (a) Over-The-Wall Engineering Approach (From Kalpakjian [1997]).
- (b) Concurrent Engineering Approach (adapted from Pugh [1996]).

| Definition of product need |
| Original concept |
| Conceptual design |
| Design analysis |
| Physical and analytical models |
| Prototype testing |
| Evaluation |
| Revised design |
| Final evaluation |
| Production drawings |
| Material specification, Process and equipment selection, Tool and die design and construction |
| Manufacturing |

DISEÑO (PRODUCTO)

FABRICACION (PROCESO)

(a)

Market analysis

Specification

Concept design

Main design flow

Detail design

Manufacture

Sell

DISEÑO (PRODUCTO)

FAB (PROC.)

(b)

Text Reference: Figure 1.1, page 5

Hamrock, Jacobson and Schmid

PRODUCT ENGINEERING PROCESS

Mechanical Design Dept		Proto shop	Industrial design	Functional lab
3D drawing	FEM, Mech ynamics, CFD	Rapid prototyping	Aesthetic evaluation	Performance evaluation

Production tools		Reliability :valuation	Production shop	Process :valuation
Prototype			Pre-series	

Suppliers

Key: ISIS Demonstrator Targets

Production

# CAx y el ciclo de vida del producto
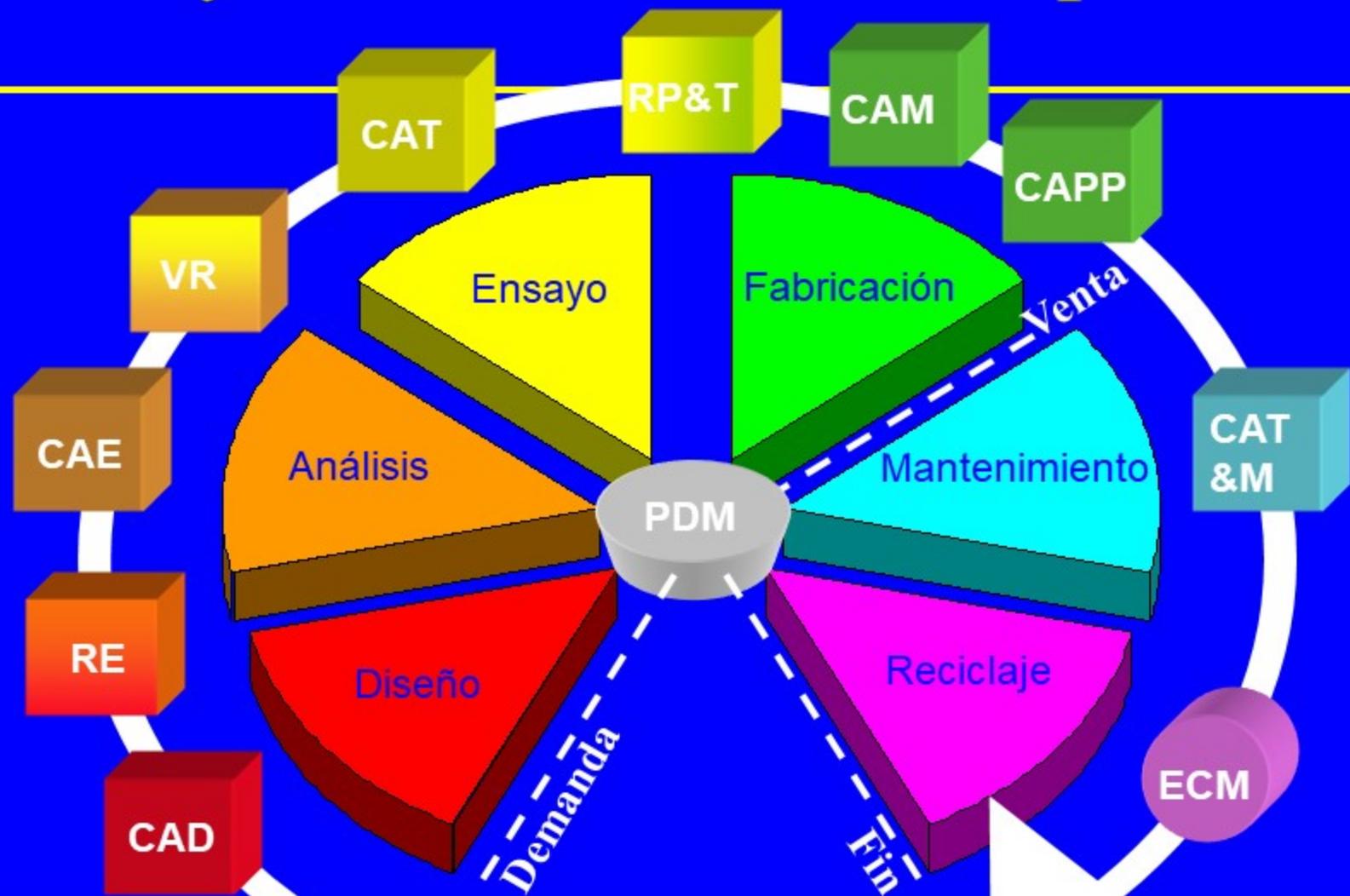
PLM: Product Lifecycle Management

- Permite manejar la enorme cantidad de información que genera una compañía en torno a un producto:
  - Geometría
  - Planos
  - Ficheros sobre piezas
  - Esquemas de montaje
  - Especificaciones
  - Programas de CN
  - Resultados de análisis
  - Diagramas de flujo de procesos
  - Correspondencia
  - Listas de material

  asegurando que la información llega a las personas adecuadas (confidencialidad) en la forma adecuada

- La información se mantiene siempre actualizada y se sabe qué modificaciones se han realizado y por parte de quién
- Realización de búsquedas
- Facilita la colaboración entre los distintos departamentos
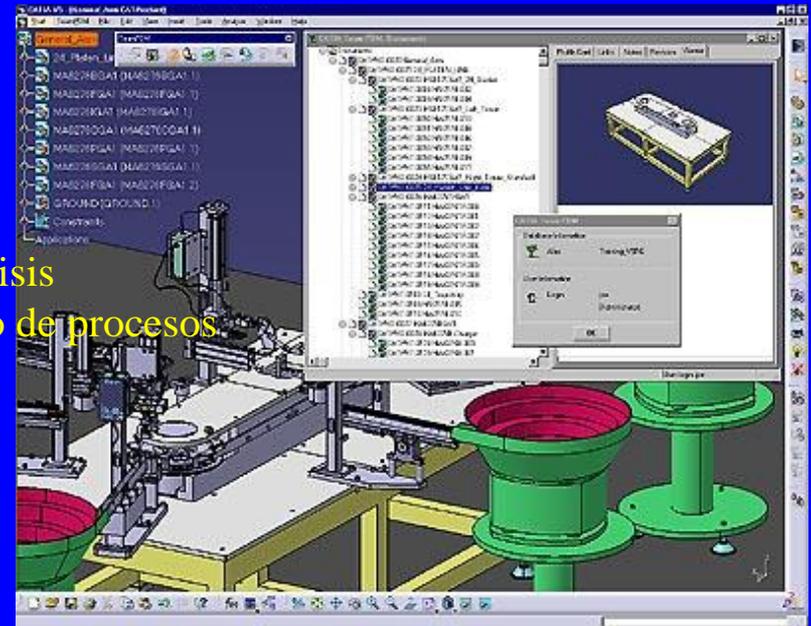
PUGSLEY ~~Pugsley~~ Safety Factor Approach

Table 1.1 Safety Factor Characterisics A, B, and C

Characteristic[a]		B=			
		vg	g	f	p
A=vg C=	vg	1.1	1.3	1.5	1.7
	g	1.2	1.45	1.7	1.95
	f	1.3	1.6	1.9	2.2
	p	1.4	1.75	2.1	2.45
A=g C=	vg	1.3	1.55	1.8	2.05
	g	1.45	1.75	2.05	2.35
	f	1.6	1.95	2.3	2.65
	p	1.75	2.15	2.55	2.95
A=f C=	vg	1.5	1.8	2.1	2.4
	g	1.7	2.05	2.4	2.75
	f	1.9	2.3	2.7	3.1
	p	2.1	2.55	3.0	3.45
A=p C=	vg	1.7	2.15	2.4	2.75
	g	1.95	2.35	2.75	3.15
	f	2.2	2.65	3.1	3.55
	p	2.45	2.95	3.45	3.95

[a]vg=very good, g=good, f=fair and p=poor
A=quality of materials, workmanship, maintenance and inspection
B=control over load applied to part
C=accuracy of stress analysis, experimental data, or experience with similar parts

Table 1.2: Safety Factor Characteristics D and E

Characteristic[a]	D=		
	ns	s	vs
E=ns	1.0	1.2	1.4
E=s	1.0	1.3	1.5
E=vs	1.2	1.4	1.6

[a]vs=very serious, s=serious and ns=not serious
D=danger to personnel
E=economic impact

Usage:

$$n_s = n_{s,x} n_{s,y}$$

n_s=safety factor
$n_{s,x}$ is obtained from Table 1.1
$n_{s,y}$ from Table 1.2