

Systems Engineering /
Biotechnology
&
Future Education Opportunities

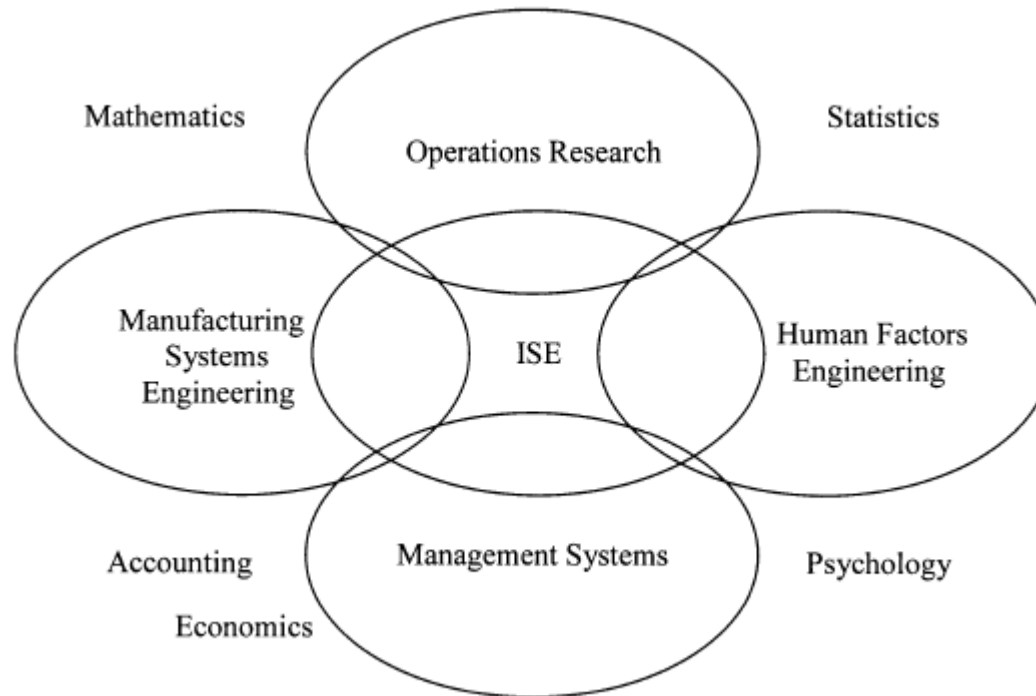
Don Peters

Nov 11, 2008

What is Systems Engineering?

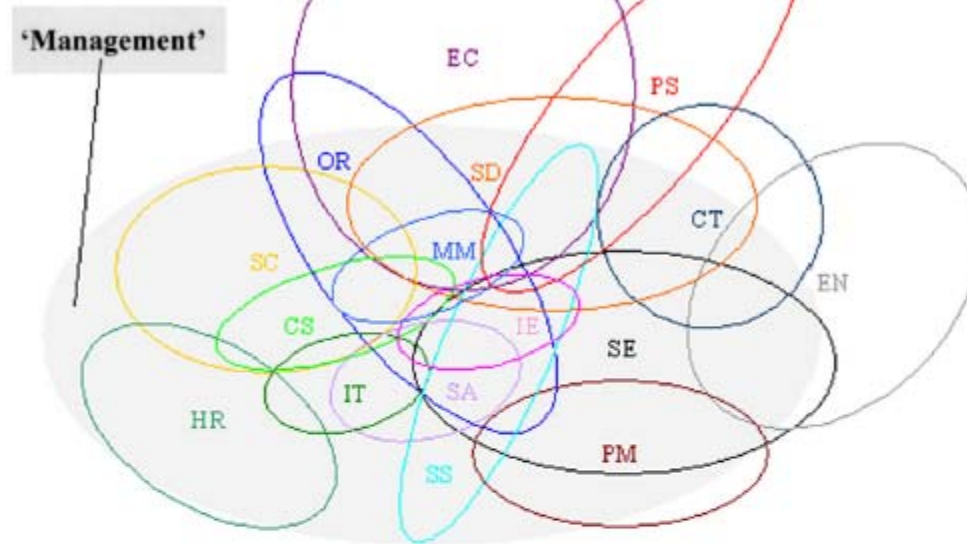
- INCOSE:
 - Systems Engineering is an interdisciplinary approach and means to enable the realization of successful systems. It focuses on defining customer needs and required functionality early in the development cycle, documenting requirements, then proceeding with design synthesis and system validation while considering the complete problem:
 - Operations
 - Performance
 - Test
 - Manufacturing
 - Systems Engineering integrates all the disciplines and specialty groups into a team effort forming a structured development process that proceeds from concept to production to operation.
 - Systems Engineering considers both the business and the technical needs of all customers with the goal of providing a quality product that meets the user needs.

Overlap of Activities - Branding



Overlap of ISE activity with other disciplines [Sink, Poirier, and Smith, 2001].

Landscape of Disciplines



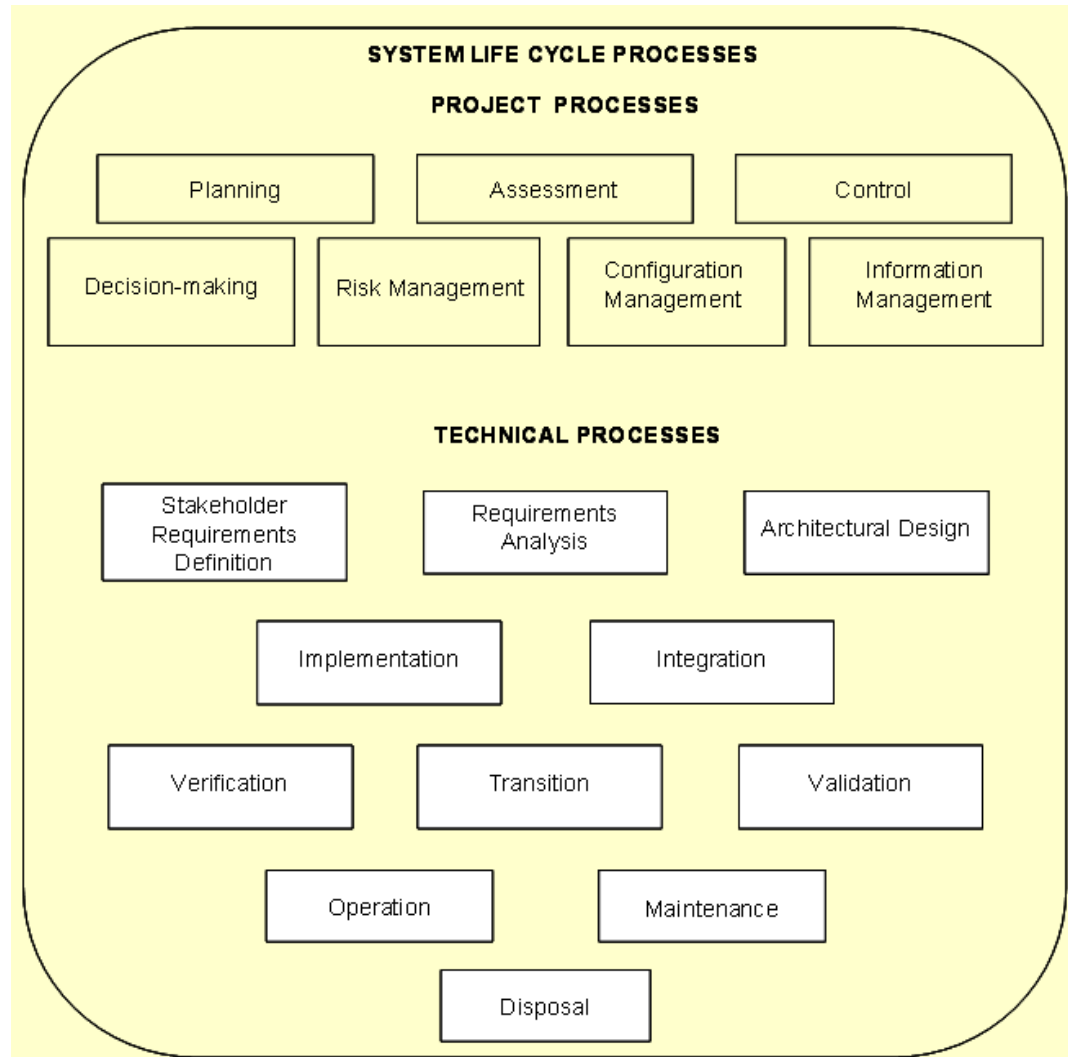
Legend

■ SE – Systems Engineering	■ EN – (Specialist) Engineering
■ OR – Operations Research	■ IT – Information Technology
■ PM – Project Management	■ PS – Psychology
■ SA – Systems Analysis	■ EC – Economics
■ SD – System Dynamics	■ HR – Human Resource Strategy
■ CT – Control Theory	■ CS – Corporate Strategy
■ SS – Soft Systems Methodology	■ MM – Marketing Management
■ IE – Industrial Engineering	■ SC – Supply Chain Management

Systems Engineering Roles

Role	Abbr.	Short Name
1	RO	Requirements Owner
2	SD	System Designer
3	SA	System Analyst
4	VV	Validation/Verification Engr.
5	LO	Logistics/Ops Engineer
6	G	Glue Among Subsystems
7	CI	Customer Interface
8	TM	Technical Manager
9	IM	Information Manager
10	PE	Process Engineer
11	CO	Coordinator
12	CA	Classified Ads SE

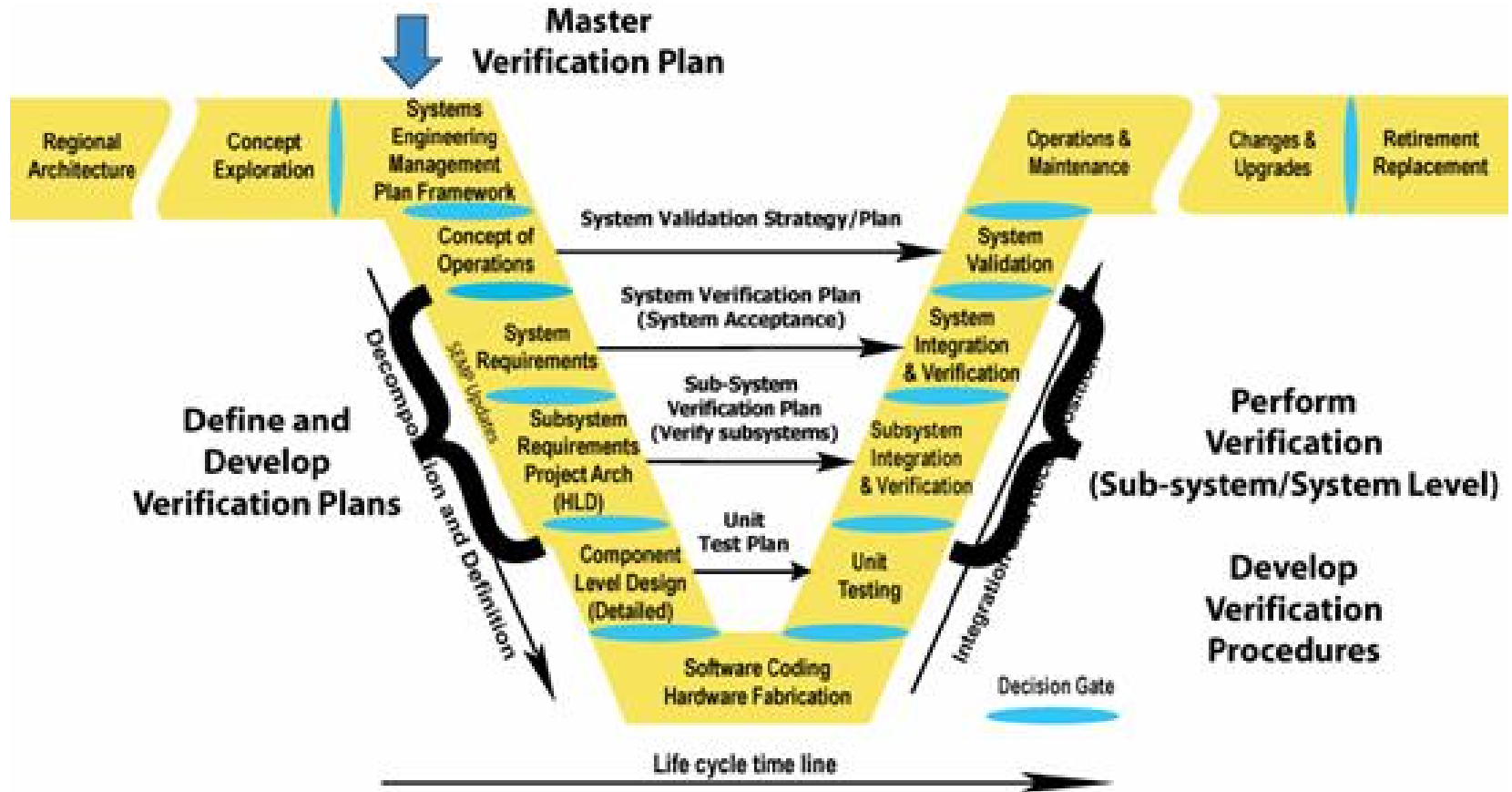
Systems Engineering Processes



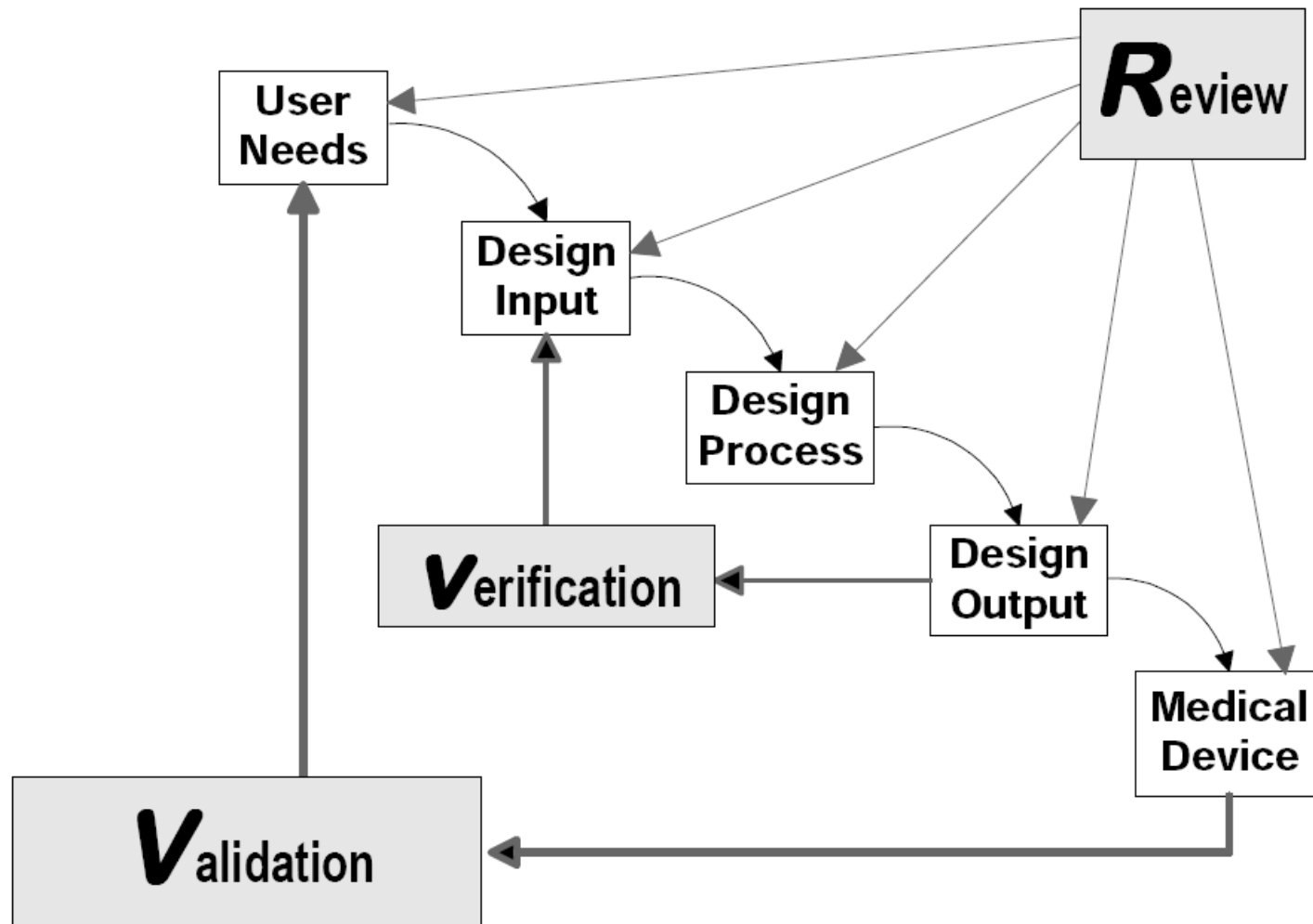
Product Life Cycle Definitions

ISO 15288	EIA 632	IEEE 1220	CMMI (<i>informal</i>)	DoD/DAG [DoDI 5000.2]
Concept	Pre-system Definition	Concept	concept, exploration, vision	Concept Development
Development	System Def., Subsystem design, Detailed design	System Def., Subsystem design, Detailed design; FAIT	feasibility, design, development	Tech Development; System Development & Demonstration
Production	End product, physical, IT&E	Production	production, manufacturing, delivery	Production & Deployment: LRIP
Utilization		Utilization	operations	Operations & Support [O&S]: FRIP
Support		Support	support, maintenance, sustainment	O&S: Sustainment
Retirement		Retirement	disposal, phase out	O&S: Disposal

V – Model Process



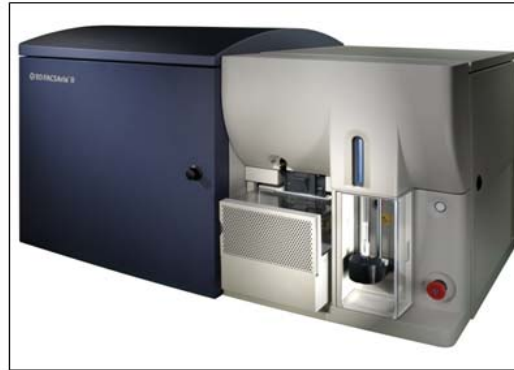
Design Control Guidance for Medical Device



BD Biosciences Segment – Key Products



**BD Pathway™
Bio-Imager**



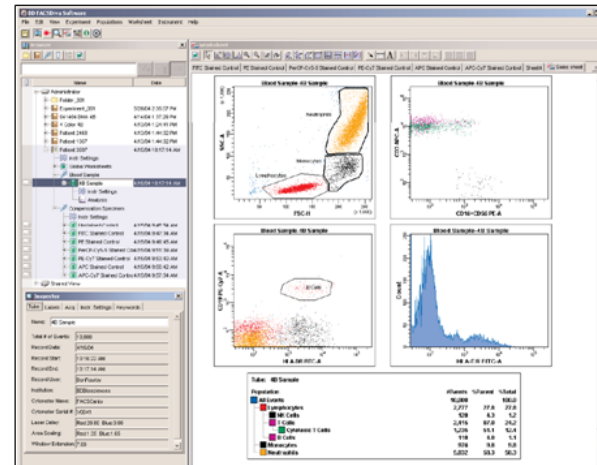
BD FACSAria™ II Cell Sorter



BD FACS Canto™ II Cytometer



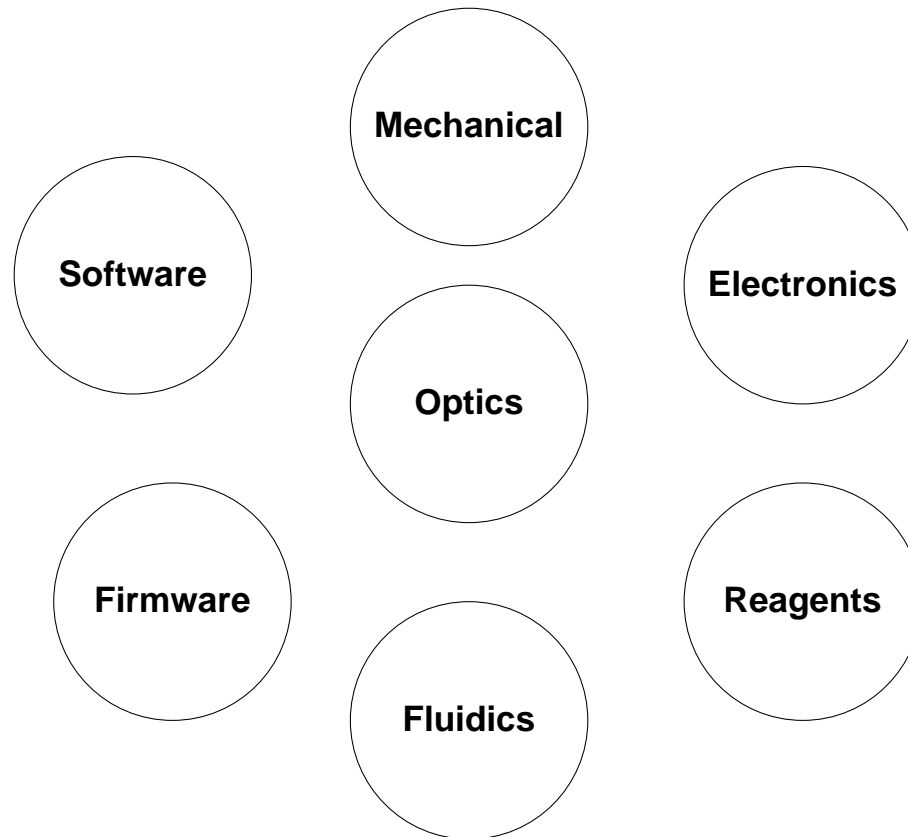
**BD Advanced Bioprocessing
Cell Culture Media
Supplements**



BD FACS Diva™ Analysis Software



Examples of Complex Subsystems

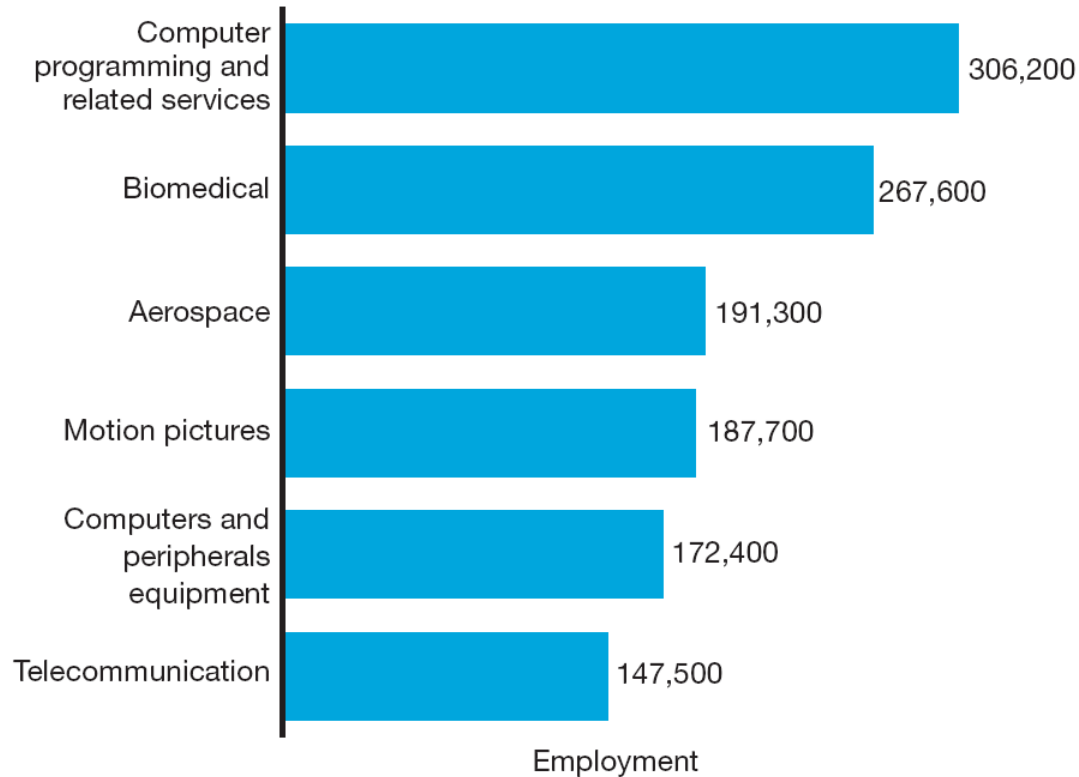


BD Biosciences California

- A high growth business
- High demand for technical employees
- Products are complex systems
- Requires multidisciplinary workforce
 - Mechanical, software, electrical, fluidics, optics, chemistry, immunology, cell biology
- High cost of living
 - Restricts recruiting
 - Entry & middle management positions are filled locally

California State Labor force Demand:

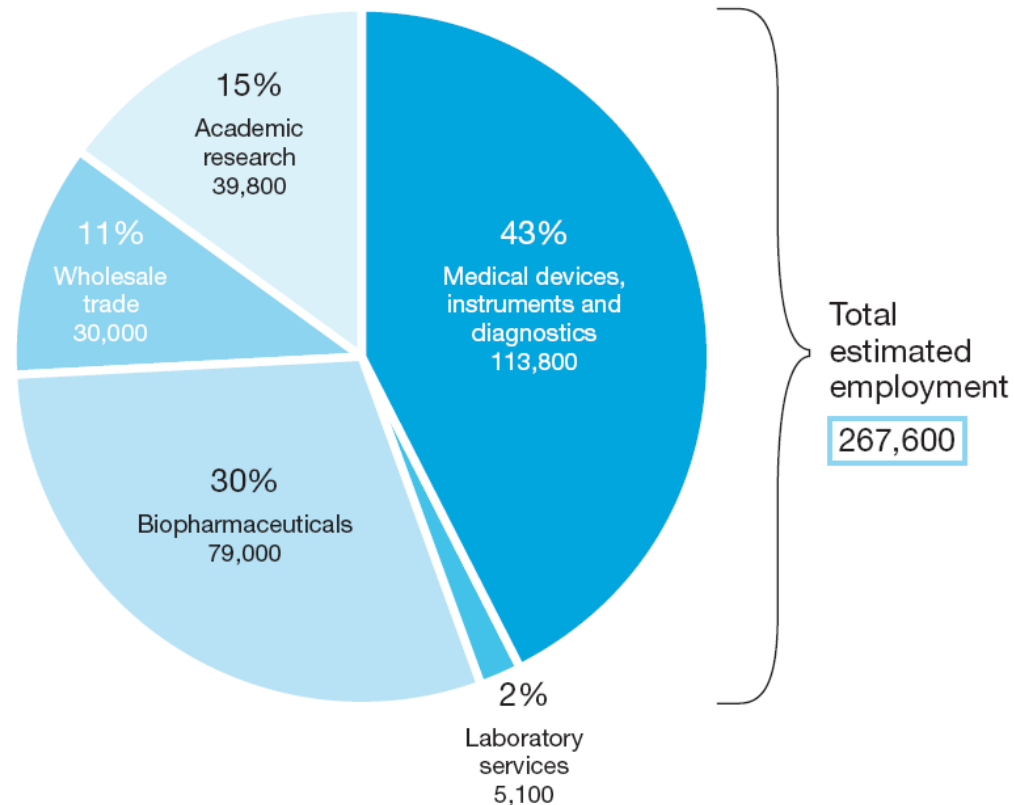
Estimated High Tech Employment 2006



Source: California Employment Development Division,
Bureau of Labor Statistics.

2008 CA Biomedical Industry Report

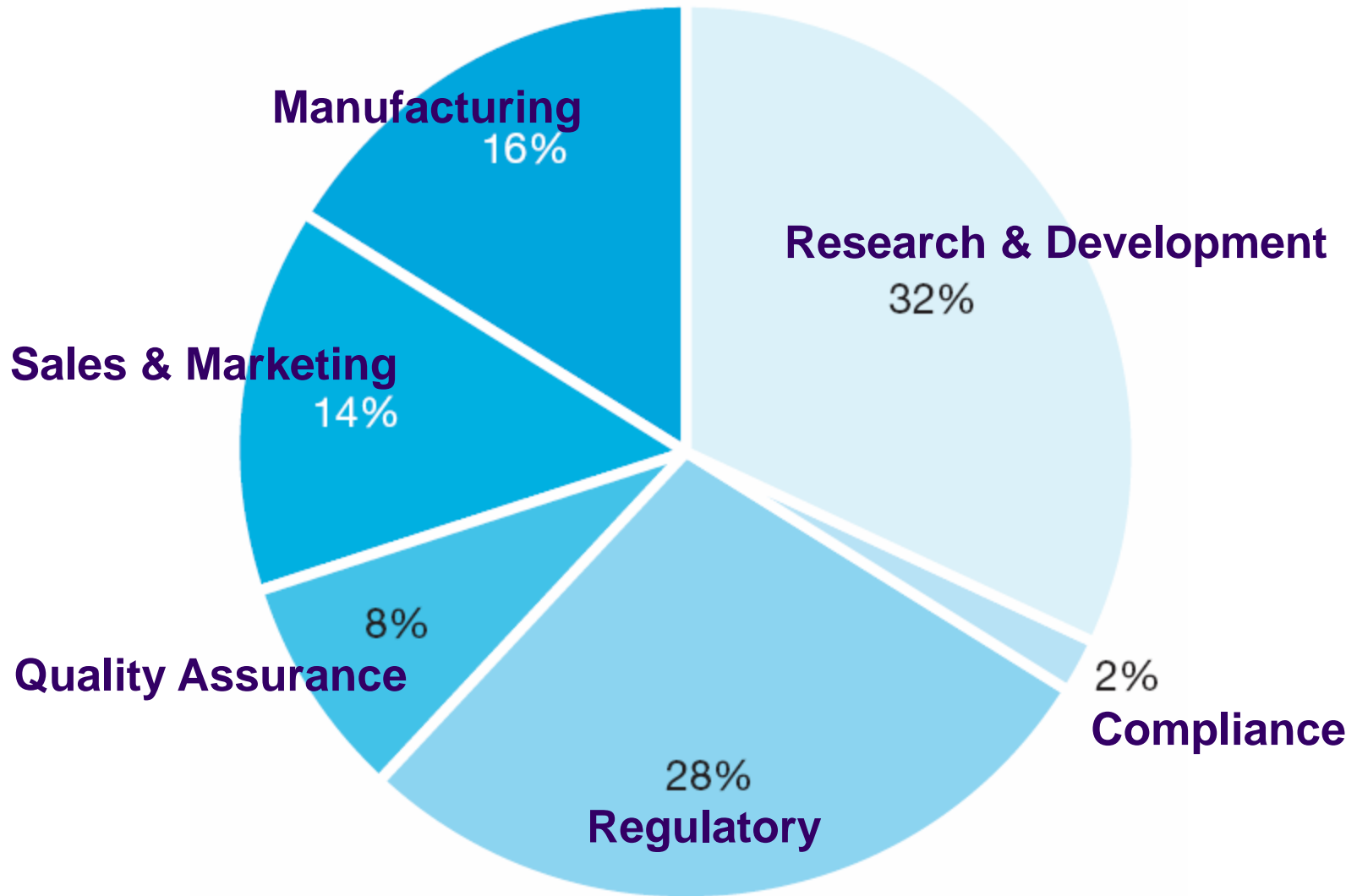
California – Biomedical Industry:



Note: Numbers may not sum to total due to rounding
Source: California Employment Development Division
Bureau of Labor Statistics and company-specific SEC filings.

2008 CA Biomedical Industry Report

California – Workforce Least Prepared



Overview – Addressing US Competitiveness:

- Current Problem Identification & Long Term Solution:
 - America COMPETES Act
 - Congress authorized NSF to develop grants to create or expand PSM programs – but not funded yet
 - Academic Competitive Council (ACC):
 - Competitiveness Bedrock - well-educated and skilled workforce.
 - Targets K-12 to Postsecondary Education
 - STEM Programs (Science, Technology, Engineering & Mathematics)
 - Feeds “pipeline” with qualified scientists and engineers

National Research Council Report – July 11, 2008

- Report Findings:
 - ‘Classic’ Natural Science Master’s degrees focuses on academic career path
 - Higher education institutions recognize need for combining scientific knowledge with professional skills (eg PSM)
 - PSM can and does attract students
 - Growing employer demand for PSM graduates
 - PSM graduates can significantly contribute to nation’s competitiveness
- Report Recommendations:
 - PSM’s should be expanded
 - Accelerate development of these programs nationwide
 - Scaling up and developing new PSM’s needs concerted effort by a number of parties, including Congress

Professional Science Masters (PSM)

Programs Include:

- Biology/Biotechnology
- Chemistry
- Computational Molecular Biology/Bioinformatics
- Computational Sciences
- Environmental Sciences
- Forensic Sciences
- Mathematics and Statistics
- Medical-Related Sciences
- National Defense
- Physics and Geological Sciences



- 120+ PSM Programs
- 60+ Institutions
- 25+ States

Mix of Disciplines

