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CONSULTING, INC.

# ***Exploiting Parallelism in Decision Engagements***

Presented to

INFORMS

by

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and

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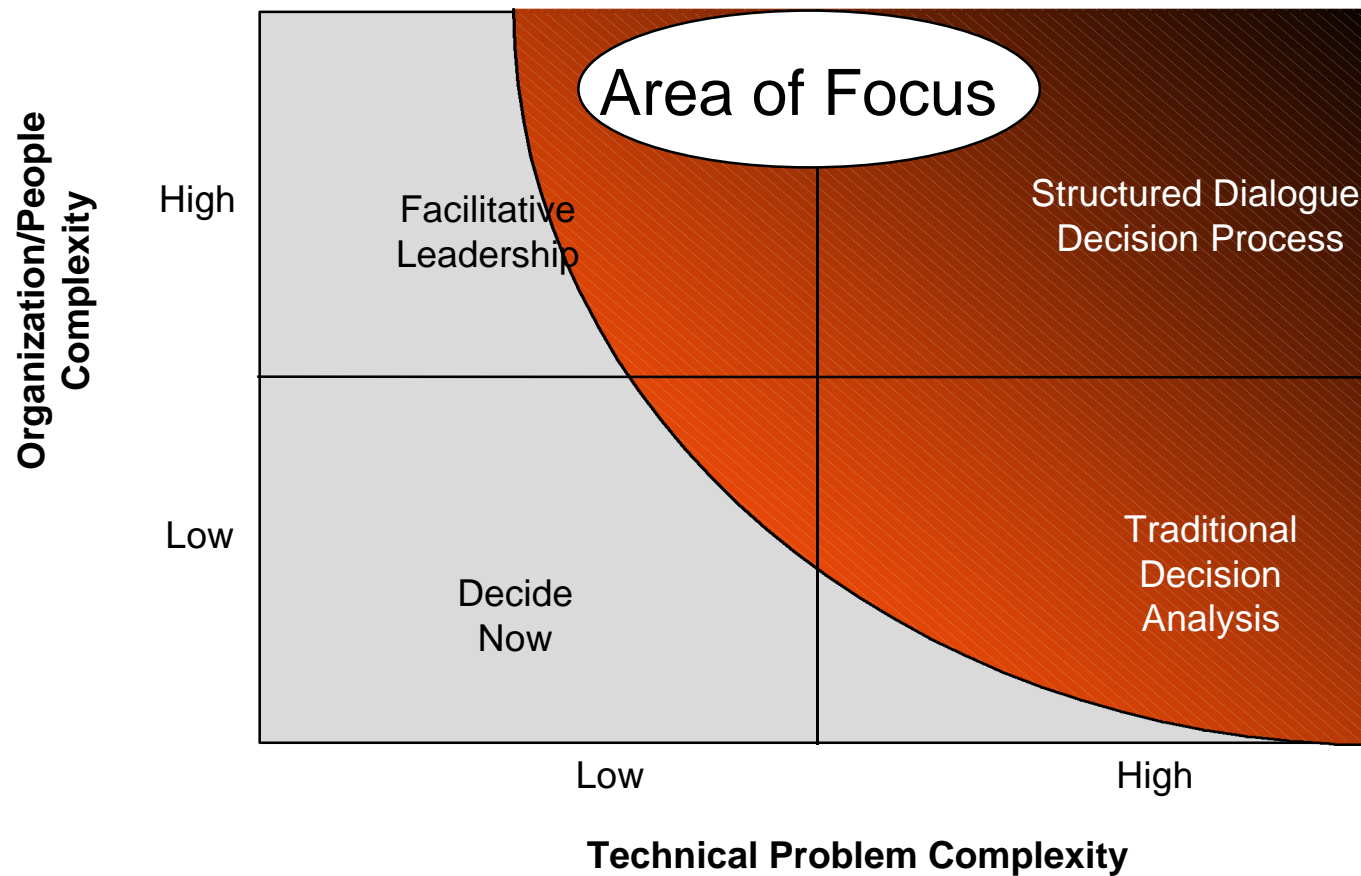
# ***Agenda***

- Motivation for Applying Parallel Computation System Concepts to DA Engagements
- Structural Definitions and Connections
- Examples of DA Engagements Improved with a Parallel Lens
- Conclusions

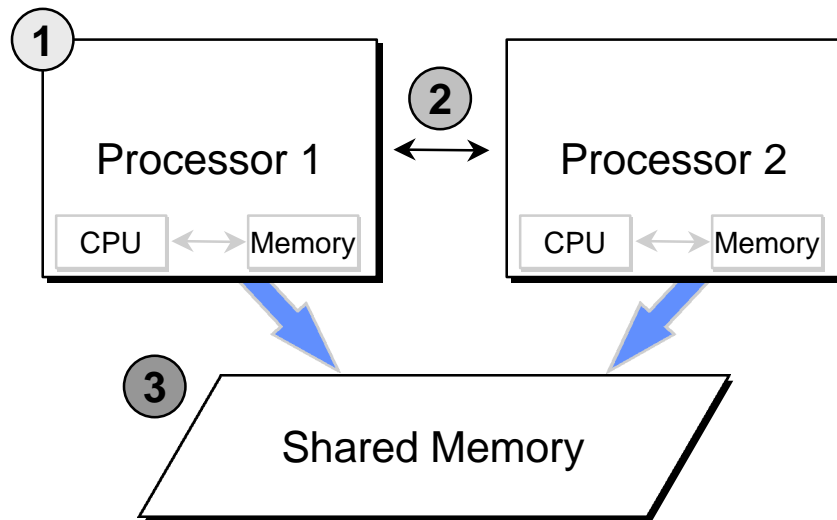
## Motivation

***We are focusing on exploiting parallelism in the people and process aspects of DA engagements.***

**Organizational and Technical Problem Complexity**

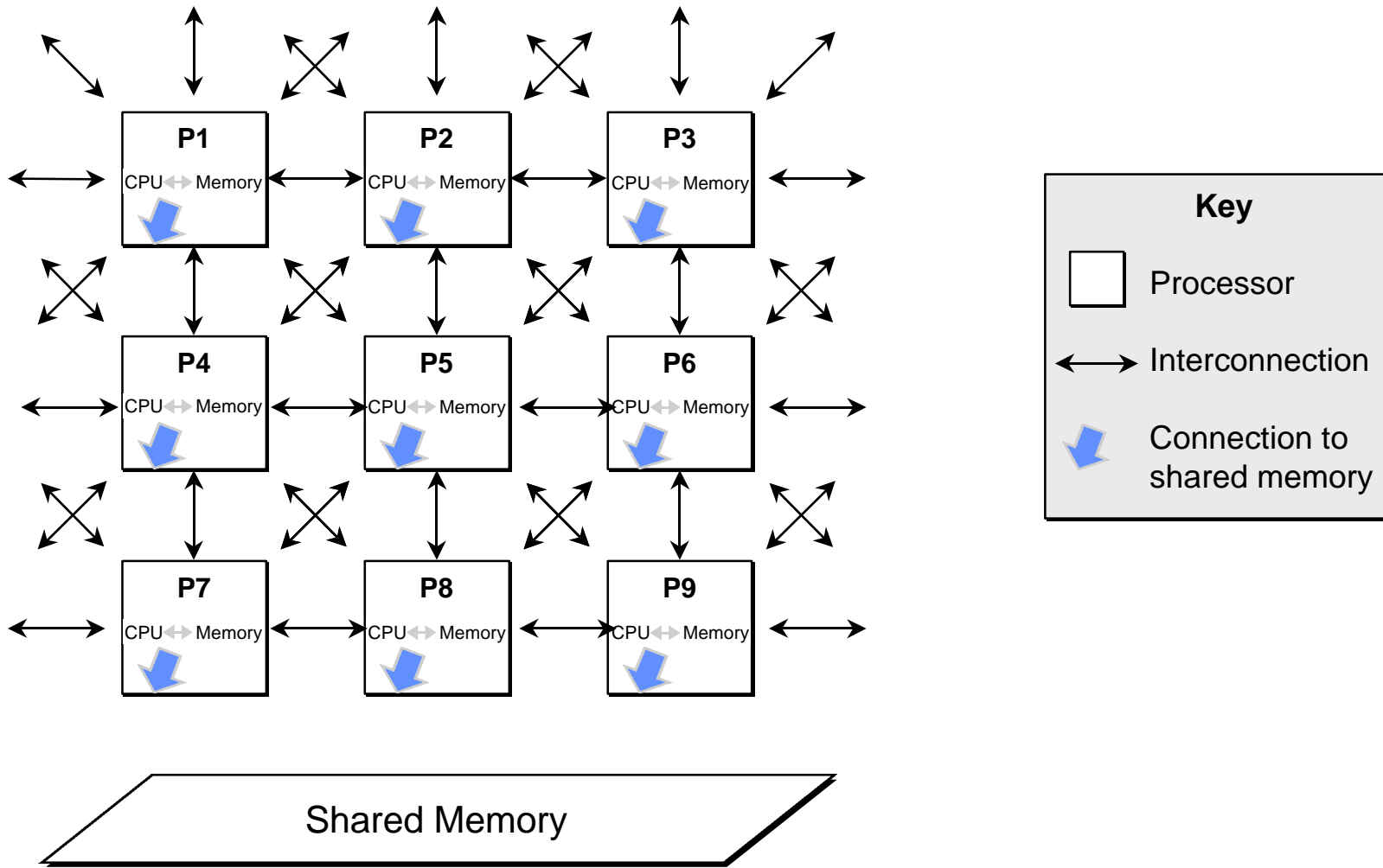


## ***A parallel computation system has three fundamental components.***

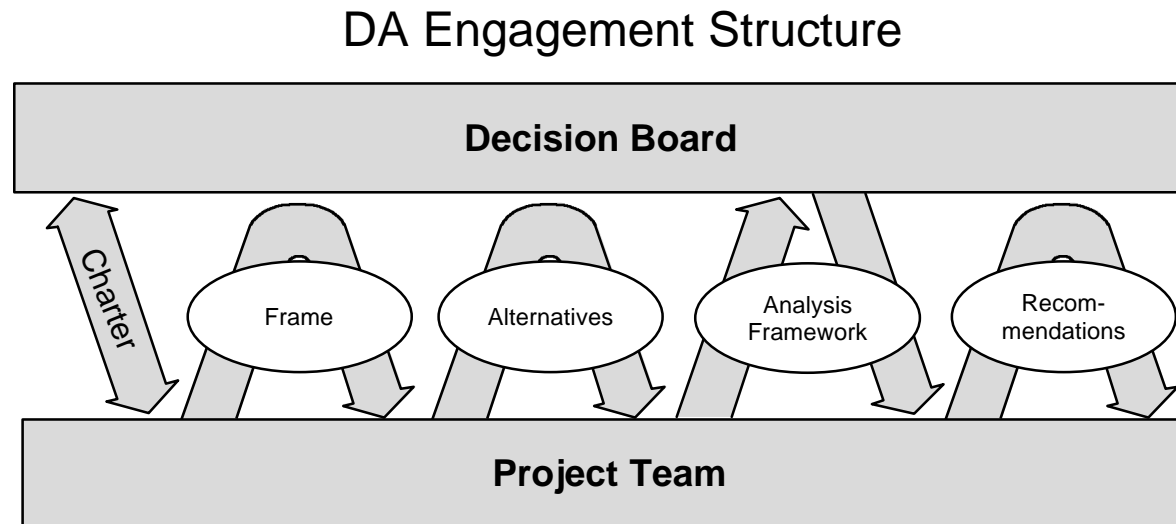


- ① **Processor**—Type based on how instructions are executed and data are stored
  - SIMD—Single instruction, multiple data
  - MIMD—Multiple instruction, multiple data
- ② **Interconnection network**—How the processors communicate results
- ③ **Shared memory**

***Here is a “standard” parallel machine with nearest neighbor connections.***



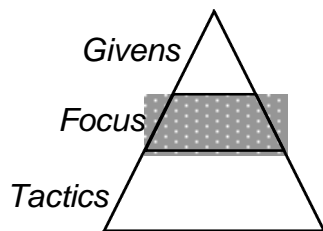
***Fundamental components of a Navigant Consulting DA engagement are the teams assembled to tackle and solve the problem.***



- Two distinct teams: the decision board and the project team
- Structured, well-defined interactions between the two teams
- Distinct phases through which an engagement progresses

# Each stage of a DA engagement can have **SIMD/MIMD** characteristics.

## Frame—Decision Hierarchy



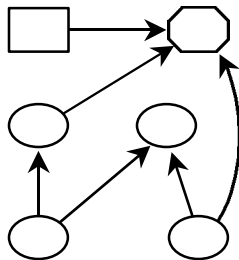
How to use it?  
 E.g., Should marketing and manufacturing work separately but each produce a similar output?

## Analysis—Model

	A	B	C
1			
2			
3			
4			
5			

How to use it?  
 E.g., In a portfolio model do we have assessments that, once constructed, can be repeated?

## Alternatives—Influence Diagram



How to use it?  
 E.g., Do we each develop IDs for particular businesses or take a part of the ID on value measures and another on dependencies?

***The analogy is driven by looking at how work is done and results are communicated.***

Parallel System/DA Engagement Analogy

**Parallel System**

Shared data MIMD model  
Connections are nearest neighbor

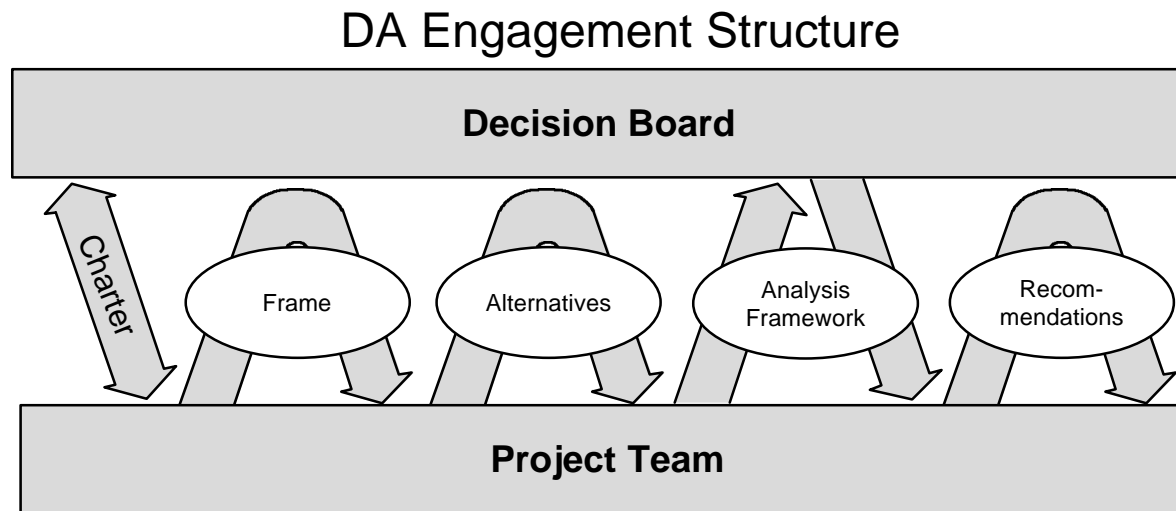
**DA Engagement**

Processing units—The people of the SIMD/MIMD type. We each have our own processing capability and our own data storage (our brains, computers, and offices).

Connections—Dialogues, e-mail, and voice mail systems. In general, we work with co-workers making a nearest neighbor connection a good choice. There are times when different levels interact (e.g., joint decision board-project team meetings).

Shared memory —The models, presentations, and other shared documents (potentially on a server)

**1. By establishing a project using the dialogue structure, we create an inherently parallel system.**



Parallelism arises in two ways:

1. Decision board and project team members work on different items.
2. The project team members divide up work.

Shared memory systems are created, such as project servers and large portfolio models.

## ***2. Project team activities have serial and parallel components.***

- Meetings are begun by reviewing an agenda and setting objectives.
  - This sets the “programming” for the meeting.
- Participants work through agenda items together (serially) or in break-out groups.
  - Determining when to break into parallel mode is a challenge.
- Clear work assignments (a basic principle of MIMD programming) ensure that work done before the next meeting is effective.
- Shared memory is created through meeting notes and participant experiences.

### ***3. Message channels and shared memory need to be well defined for maximum effectiveness.***

- Establish interconnections for message channels (one-to-one conversations, e-mail, and voice mail).
  - For example, in e-mail we define the group list (interconnection) and the content protocol
    - e.g., use descriptive subject headers and clear directions.
- Define the types of documents that should be stored in shared memory systems (e.g., project servers and project file cabinets).
  - Developing markers enables others to know which particular documents are important for them.

***In practice, we recommend using the parallel system framework to think about project management.***

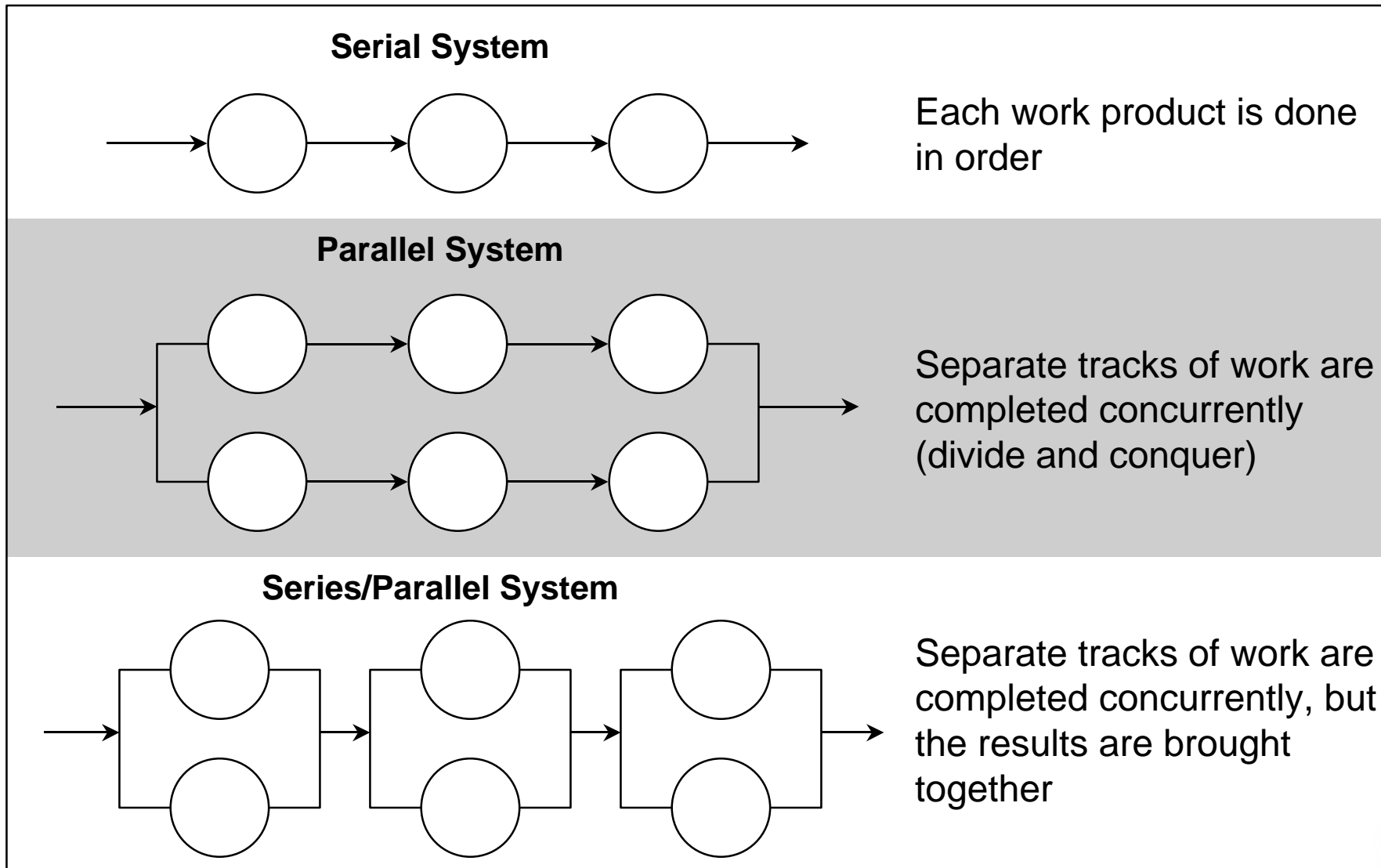
- Spend framing time to explicitly decide what is parallel, what is serial, what is SIMD, and what is MIMD.
- Determine the interconnection network for the project.
- Create a shared memory that is used effectively and is not just an archive for every documented created.

## ***Using the parallel system/DA engagement analogy gives us real advantages.***

- Effective use of resources through the use of serial/parallel work breakouts
- Different or higher quality project results through the more effective use of information
- Improved organizational alignment by clearly establishing the teams and effectively using shared memory and interconnection networks
  - Specifically, people get what they expect and know how what to make of it.

# ***Appendix***

# ***Serial/parallel hybrids are a useful way to divide work.***



## ***The promise of speedup with parallel systems seems great but is limited by Amdahl's Law.***

$$\text{Speedup} = 100 / (100 - f + f/p)$$

Where

- $f$  = the percentage of the task that can be parallelized and  $p$  is the number of processors
- $(100 - f)$  = the serial tasks and  $f/p$  represents the parallel tasks

An example:

- 90% of a job is parallelizable on a 64-processor machine
- Speedup is 8.76x, not 64x

Implication: Large numbers of processors can increase the speed, leaving a problem bounded by the serial part of a problem.

## ***The nature of the problem and resources determine the use of SIMD or MIMD structures.***

- For example, if we have expert DA resources, we can use a MIMD approach because each expert can develop a problem. If we have newly trained DA resources, a SIMD approach with explicit problem development steps is needed.
- In general, common and repeated steps constitute SIMD (say, a pharma portfolio)
- For MIMD, you can focus on the end deliverable.