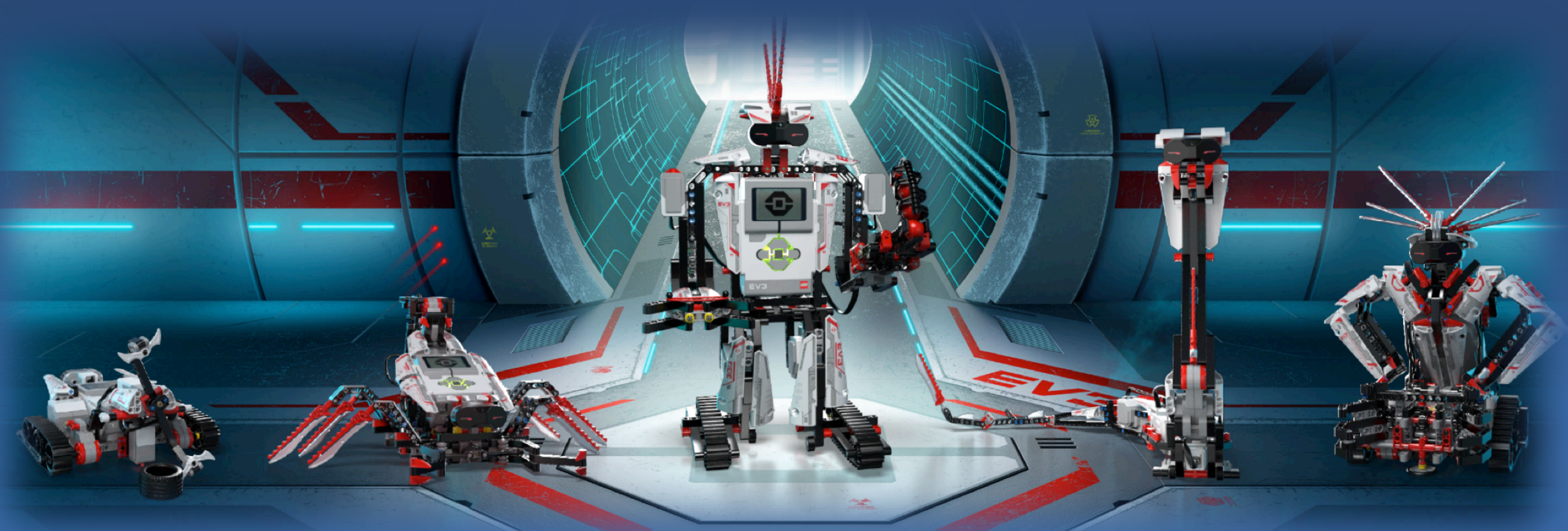
McGill Electrical and Computer Engineering

David A Lowther, Frank P Ferrie & Benoit Boulet

present



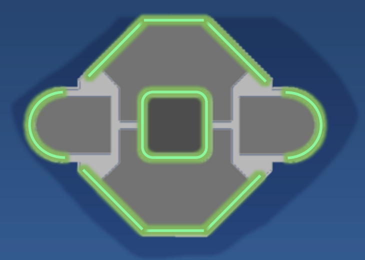
Updated slide design by Younes Boubekeur

McGill Electrical and Computer Engineering

ECSE 211

Design Principles and Methods

Winter 2019



About the Instructors

David A Lowther Ph.D., CNAA, UK
Research areas: Computational electromagnetics

McConnell Engineering MC-619 david.lowther@mcgill.ca

Frank P Ferrie Ph.D., McGill
Research areas: Artificial perception, active vision, robotics.

McConnell Engineering MC-441 frank.ferrie@mcgill.ca

Benoit Boulet Ph.D., Toronto
Research areas: Systems and Control.

McConnell Engineering MC-633 benoit.boulet@mcgill.ca

Objectives of this course

- To introduce **engineering** as an art, science, and profession
- To understand the process of **design**
- To explore design using a systems-oriented perspective
- To gain practical experience in design using building blocks comprised of electrical, mechanical, and software-based design elements
- To explore various techniques and tools for design, analysis, and simulation of electro-mechanical systems
- To gain experience in working in teams and managing the **design process**
- To understand the background that you need and why the ECE curriculum contains the courses that it does.
- To work hard, learn new things, and have fun at the same time!

What are the pre-requisites for this course?

- At least a high school or CÉGEP level course in mechanics (e.g. PHYS 131)
- You have taken Electric Circuits 1 (ECSE 200)
- Basic programming skills (ECSE 202 or equivalent)

How is the course structured?

- A 12 week project structured to provide an introduction to design and to experiment with different aspects of electrical, computer and software engineering
- A series of 5 laboratories that survey the basic concepts needed for the course
- A series of lectures organized around design theory and concepts investigated in the laboratory.

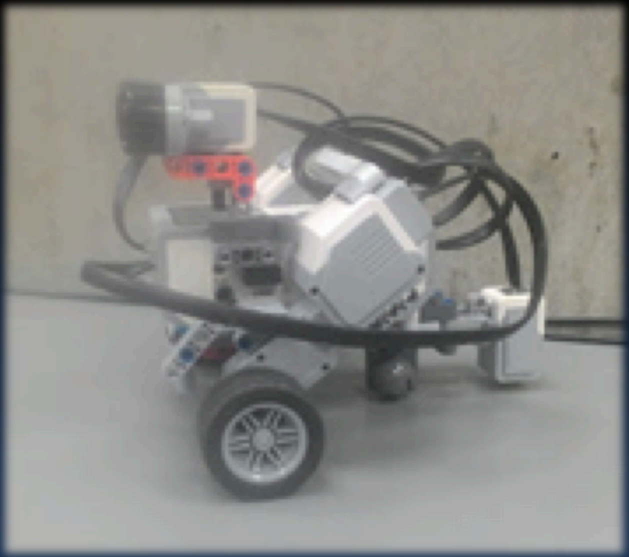
And this semester's project is…

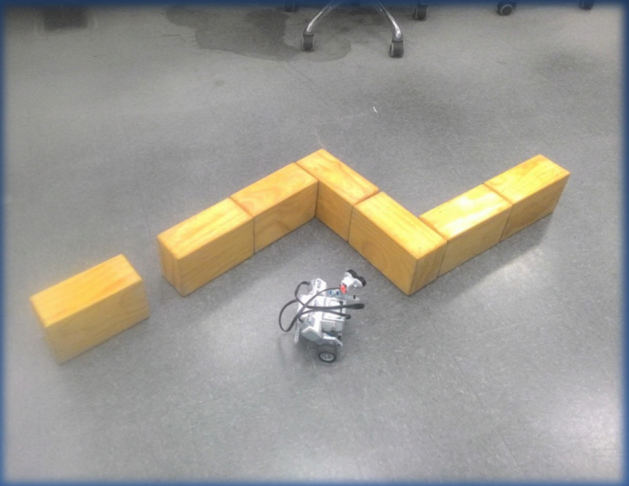
Add super-secret project here!

About the Labs

- Will explore systems that can sense, reason, and act on/in their environment
- Allow you to apply basic concepts of mechanics, electric circuits, and computer control

Lab 1: Intro to the EV3, robot control
Lab 2: Odometry for mobile robot
Lab 3: Sensors and Control
Lab 4: Localization and Navigation
Lab 5: Project related

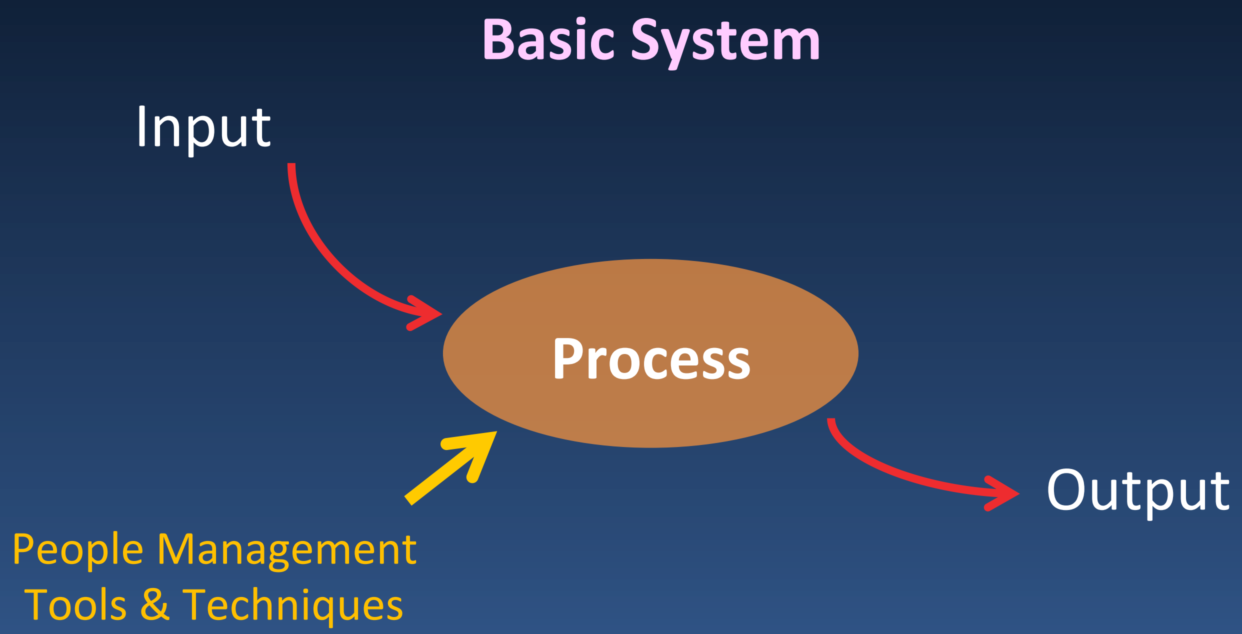




Team 10, Fall 2017

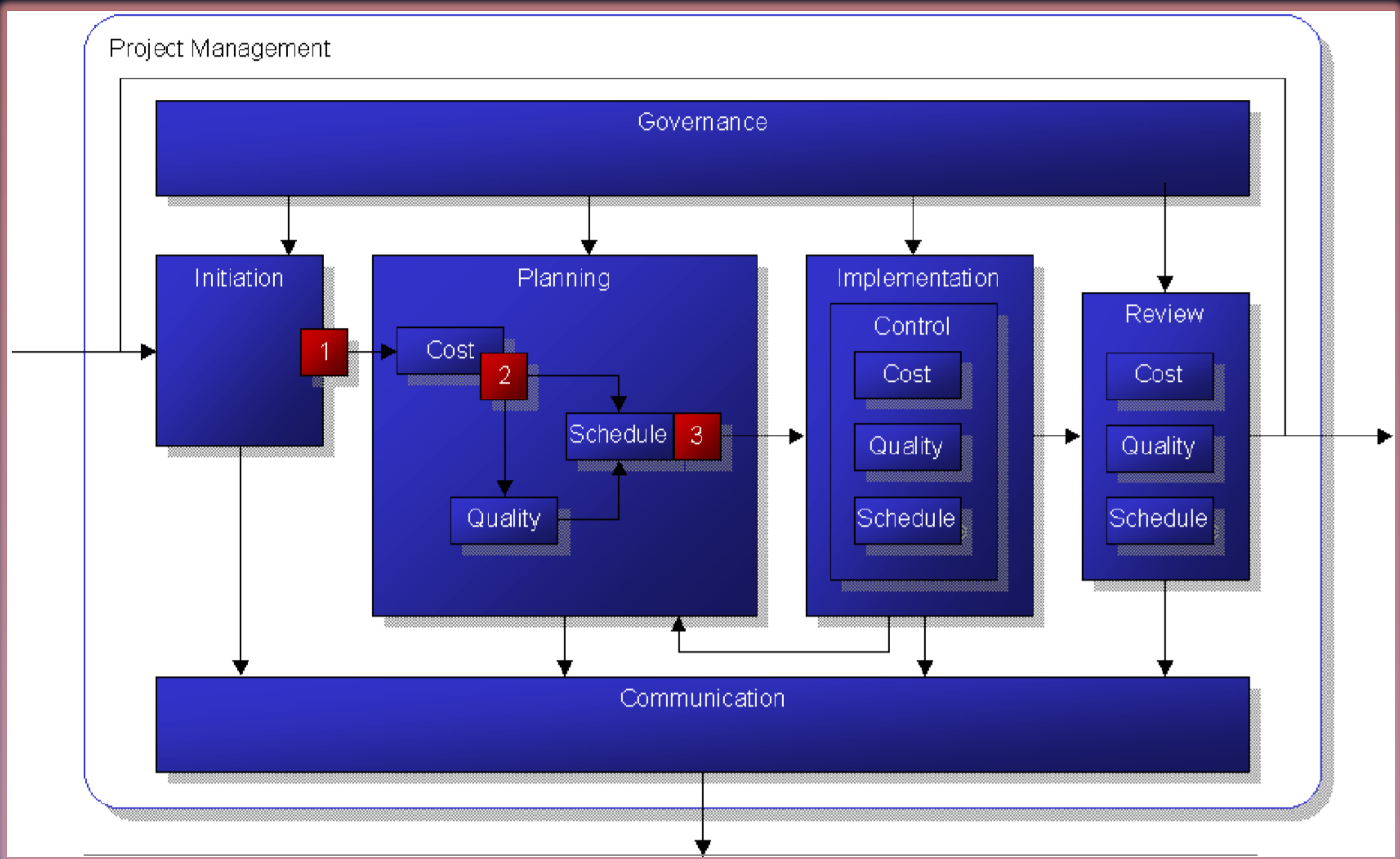
An engineer's view of the world:

- Visualization using models
- Permits "big picture" view while addressing specific details
- So-called "Systems View"



The design process uses these representations as a basis for reasoning.

In fact, the “Systems View” is prevalent across most disciplines: engineering, sciences, economics, social sciences…



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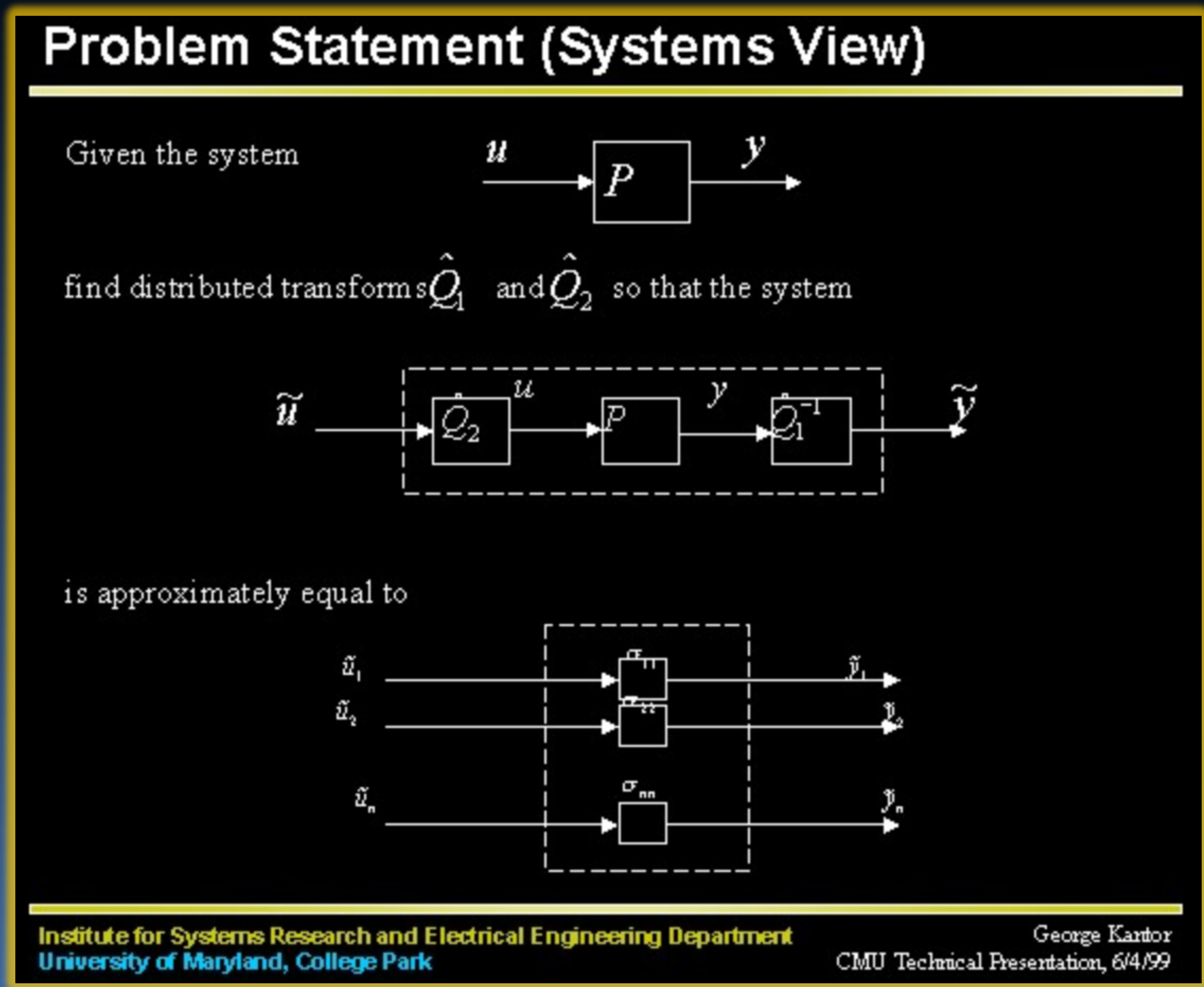

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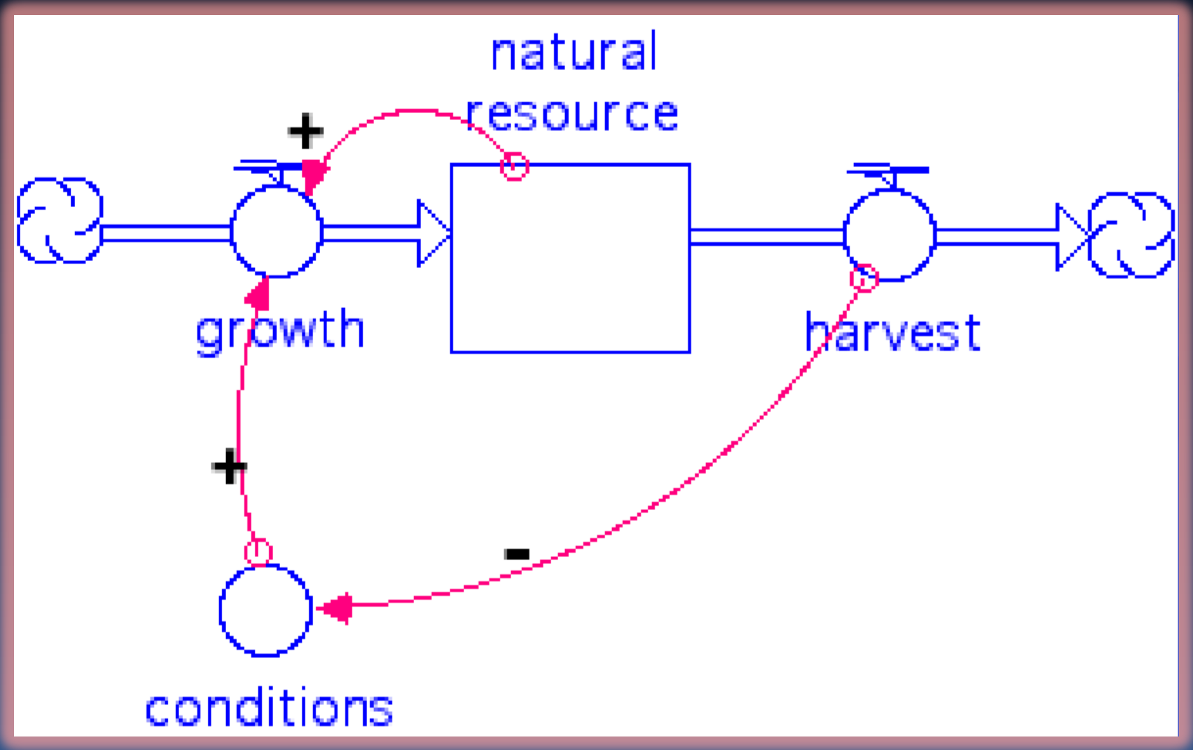

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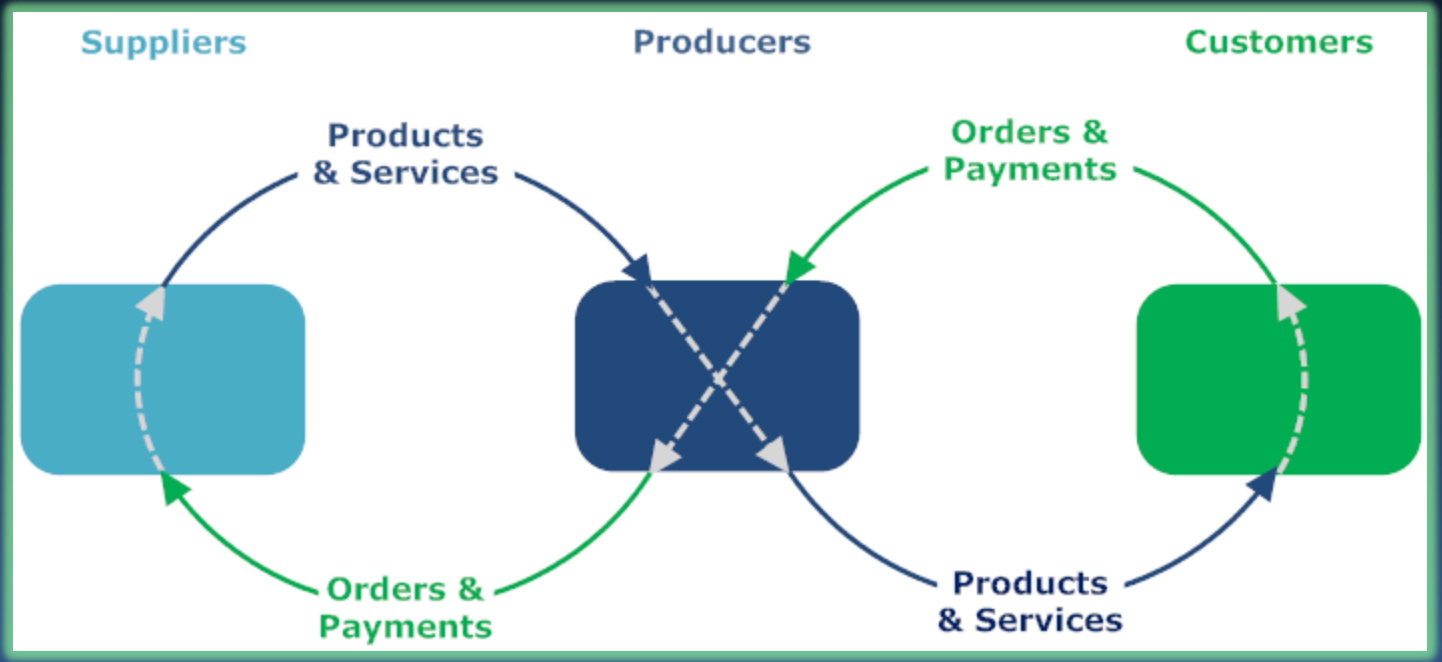

Fred Nickols

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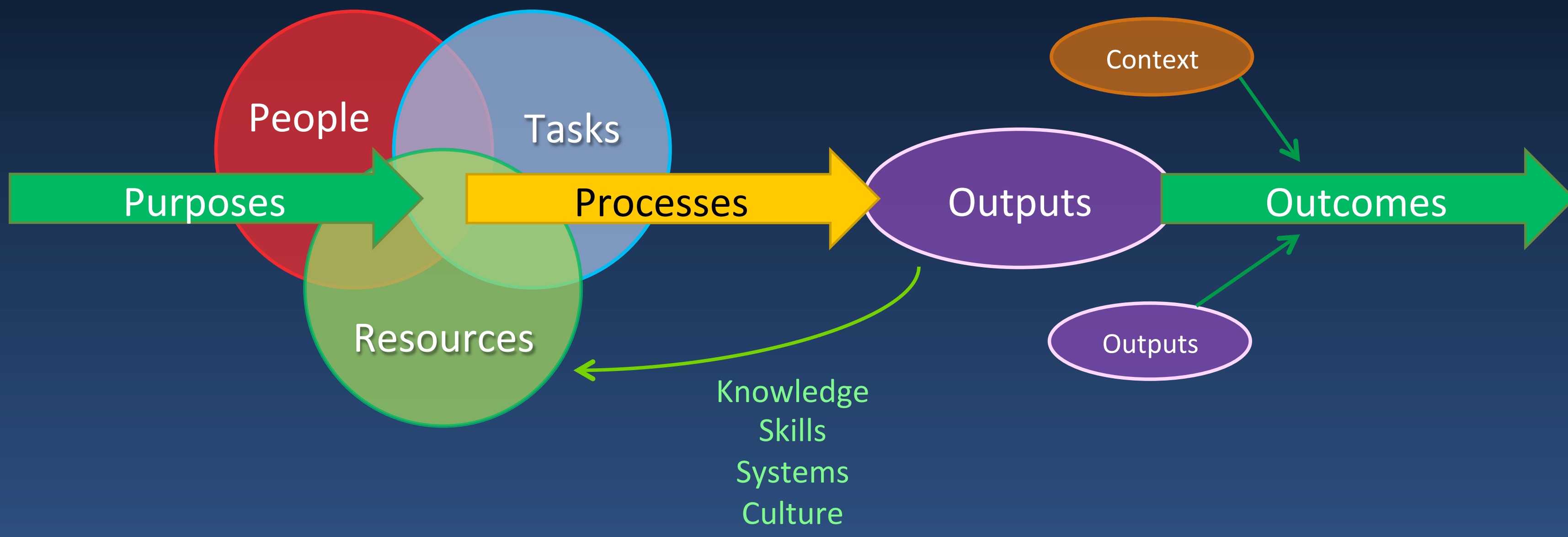
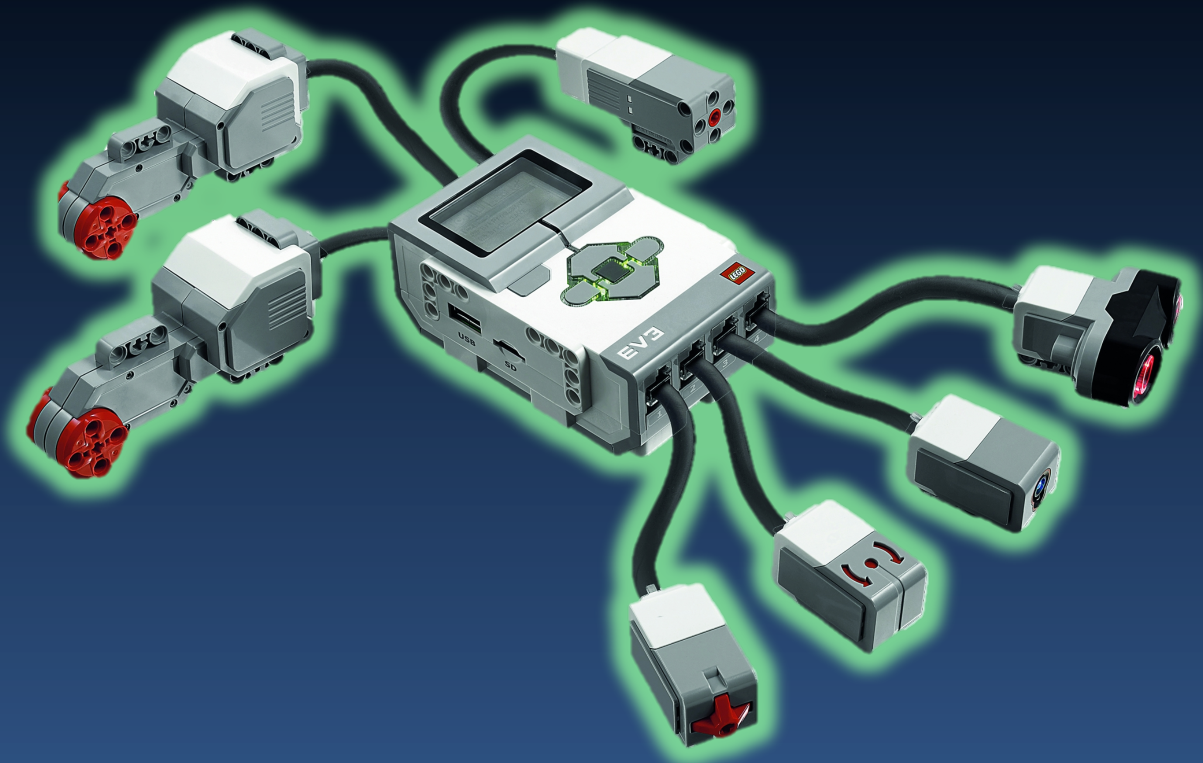


In the context of the systems view,



the EV3 should look quite familiar.

Lego® Mindstorms EV3 Specifications:

- Same ARM technology found in cell phones
- More powerful than many controllers in our robotics labs
- Strongly related to the JVM and the architectures you may study in later courses
- Fully documented to the component level, extensible

Processor	ARM9, 300 MHz, 16 MB Flash
Main memory (RAM)	64 MB = 0.064 GB (!)
Operating System	LeJOS, Linux-based
Sensor ports	4 Analog; Digital, up to 460.8 Kb/s (UART)
Motor ports	4, with encoders
USB Communication	High speed v2.0 (480 Mbit/s)
USB Host	Daisy-chain (3 levels), Wi-Fi dongle, USB Storage
MicroSD card slot	Up to 16 GB*
User Interface	6 Buttons with Backlight, handy for debugging and status
Display	LCD Matrix, monochrome; 178 x 128 Pixel

You will need to overcome these constraints!

About the theoretical background

• Will be covered in class lectures to the extent necessary

• Is broken down into the following lecture blocks:

1. The EV3 and its programming/development enviro
2. Data acquisition, sensors and control
3. Circuits and electro-mechanics
4. Mechanical systems
5. Design and sensitivity analysis
6. Design theory and tools

• Each block of lectures precedes a corresponding experiment by 1 week

• The last 6-7 weeks of the course are devoted entirely to the class design project.

```
// there will be a delay here
usSensor.getDistanceMode().fetchSample(usData, 0);
dist = (int) (usData[0]*100);

if(dist>DISTANCE_THRESHOLD && count<=3){ //filter for false
    count++;
    return distance;
```

Class Design Project

- Design skills are acquired by *doing*
- Project for Winter 2019: **TBD**
- Groups of 6, class competition (closest to target, minimum time)
- 6-7 week duration, weekly progress reports, final design presentation

Evaluation

- Laboratories 30% (6% each)
- Midterm Exam 10%, on February 13th
- Design Project 40%, for all components
- Final Presentation 20%, on March 29th