

## Representation

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Representation is the most important yet underappreciated concepts of Modelling and Simulation (M&S). The reason this is so is due to hierarchies that we take for granted. By hierarchies I mean that there is a layer of representation of us as individuals, as military professional, as members of a military unit and as citizens of an entire nation. My purpose is to provide instances of this at every level and tie it into how all of this is represented on one form or another through history, psychology, organisational behaviour, sociology, political science and its significance to M&S.

While this appears at first idealistic at best or unattainable at worst, here is why. First and foremost, we take ourselves for granted and do not realize how representation defines us. The best example is religion. Although many in the lecture hall wear a military uniform and exude common norms of professionalism, each one can walk down the streets of any city and feel different emotions when looking at houses of worship. All of us feel something different; for some – absolutely nothing, for others familiarity or even a sense of kinship while others feel pangs of contemptuousness. The psychologist Carl Jung noticed this about people.<sup>1</sup> Of the Christian cross, Jung noted that it carried a much different significance (p.81) if found after one's name in a book signifying their death as opposed to its placement on a building. Jung researched early Christianity and discovered that the crossbeam of its Latin cross was purposefully moved higher than the equilateral orthodox one to signify the otherworldliness of 'heaven above earth' (p.271). People either in uniform or out make snap judgments whether we realize it or not.

In America for example, people still respond with 'Gesundheit' when strangers sneeze yet do not speak German nor realize that the word means 'health.' In the event you ever travel to America and people ask how you are, you can tell each one about your aches pains and worries but you will never get much done. I have teenaged children that ask me 'guess what?' even I haven't a clue what I am supposed to guess about. This is how my children obtain parity or making the conversation more equal than when they were smaller children. Another curious phenomenon involves status. If we saw someone in a special suit opening the door of a luxury automobile for a female, we do not know if it is because of gender, her status or because she was merely a passenger. All of us might draw different conclusions.

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<sup>1</sup> Jung, C., 1968. *Man and His Symbols*. New York: Laurel.

Little, D. (2006) Representation. In *Integration of Modelling and Simulation* (pp. 2-1 – 2-2). Educational Notes RTO-EN-MSG-043, Paper 2. Neuilly-sur-Seine, France: RTO. Available from: <http://www.rto.nato.int/abstracts.asp>.

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## Representation

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Some of you will wonder what the relevancy is between this and representation in military M&S. It is this. When I show someone a map; which after all is a representation of the earth, I get a different reaction showing a mountain range to a member of Italy's Alpini Corps than I would from a Naval Officer based in Trento. The explanation for this is best broken down into three categories: Model, Simulation and Federation. Both are officers driven by a desire to serve their nation under the most austere of circumstances. Their respective 'model' in this case carries different preferences and means in which they render this national service. As a live simulation, one climbed very steep mountains while another traversed a great expanse of water. While each is equally patriotic, they wear the insignia, accoutrements, uniforms and even the traditions of different 'federations.'

When we talk of models to incorporate into our training, some of our preferences differ greatly where matters of resolution, fidelity and aggregation are concerned. Some of us want the heat of battle, while others want the detached perspective of the grand strategy with all of its pieces arrayed before them. Some of us need to see an overhead view of fighting vehicles engaged in combat while others conceptualise the battle based on blinking rectangular headquarters icons over a computer screen's map. When representation is decided for you or not, you are expected to make up for its shortcomings. As advanced as some of the technologies are in M&S, we do not have entities or soldiers able to show us every conceivable skill in the manual equally among all models. The only way to know where the boundaries are requires an analysis of the behaviours or competencies involved given the specific training tasks that will culminate into the mission success conceived by the commander.

Where representation in M&S offers profundity is when there is disequilibrium between individuals, systems, staff processes and ultimately decisions that would otherwise remain undiscovered. When animate objects such as soldiers and staffs are coupled with inanimate objects such as weapons systems, staff procedures or doctrine, we in turn have what is best described as systems representation. For those that appreciate Swedish military history, King Gustav Adolph understood system representation when he had ranks alternately loading, aiming, firing, kneeling and reloading in succession of each other. There are many instances where people and objects act inconsistently with one another causing equipment breakdown or worse accidents. In other cases accidents happen because authors could not foresee every single circumstance.

The background features a faded cityscape on the left and a map interface on the right. The map interface includes a menu bar with 'Filters', 'Map', 'Reports', and 'Supervisory'. The map shows a grid with coordinates (e.g., 59, 58, 57, 56) and various labels like 'MIRAS VILEVAHARA', 'SANTANA VILIA', 'IPCL', 'IPCLIR', 'IPCLIRCO', 'IPCLIRCOB', 'IPCLIRCOE', 'IPCLIRCOF', 'IPCLIRCOG', 'IPCLIRCOH', 'IPCLIRCOI', 'IPCLIRCOJ', 'IPCLIRCOK', 'IPCLIRCOL', 'IPCLIRCOM', 'IPCLIRCON', 'IPCLIRCOO', 'IPCLIRCOQ', 'IPCLIRCOR', 'IPCLIRCOS', 'IPCLIRCOU', 'IPCLIRCOV', 'IPCLIRCOW', 'IPCLIRCOX', 'IPCLIRCOY', 'IPCLIRCOZ'. The map also shows 'Saturn' and 'Kemer Saha'. The map interface also includes a status bar with 'Cursor: CR2592568', 'Centre: CR2492568', 'Scale: 1:50,000', 'Zoom: x2', and 'Filters: 1'.

# *Representation in M&S*

*Mr. Daniel Little*

***Battle Command, Simulation & Experimentation***

***Directorate (BCSE)***

# Learning Objectives

Describe the concepts of representation in M&S.

Describe representation.

Describe system representation.

Describe human and organisational behaviour representation.

# Representation Surrounds Us

## Visual Symbols



[www.theodora.com/flags](http://www.theodora.com/flags)

## Verbal Expression

*'Gesundheit!'*

*'Hi, how are you?'*

*'Guess What?'*

## Norms



# You and Representation

## Your Development:

- Youth organisation (Model)
- Drivers' Education (Simulation)
- Sports (Federation)

## Your Service to Nation:

- National Values (Model)
- Training Standards such as battle drills, medical evacuation, etc. (Simulation)
- Commands (Federation)

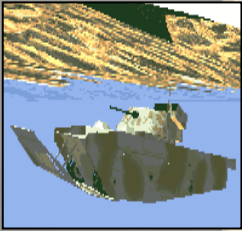
## Things that Represent You:

- Power of Attorney (Model)
- Pharmaceutical trials, time-motion study, job analysis (Simulation)
- Lawmakers – Federal, State, Local (Federation)

# Choosing a Model is a Decision Process of Representational Trade-offs

Mid resolution

Low resolution



High resolution

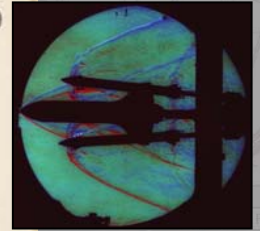


Mid fidelity

Low fidelity

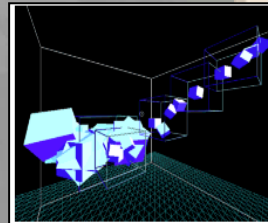


High fidelity

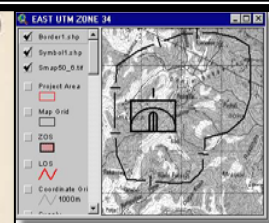


Mid aggregation

Low aggregation

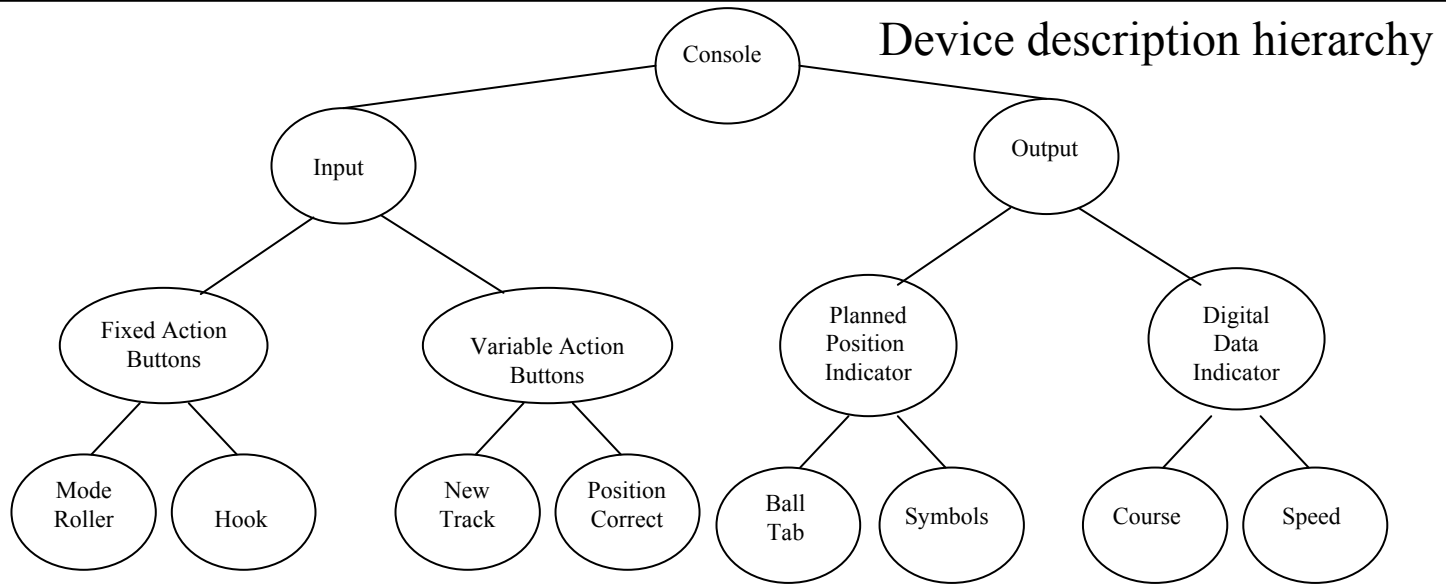


High aggregation

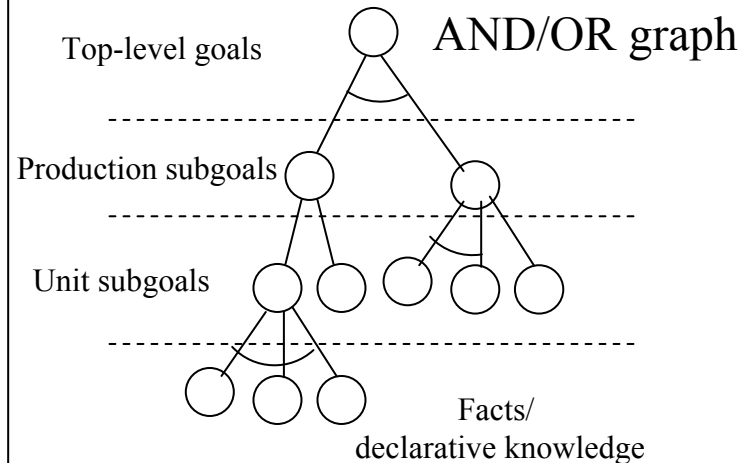
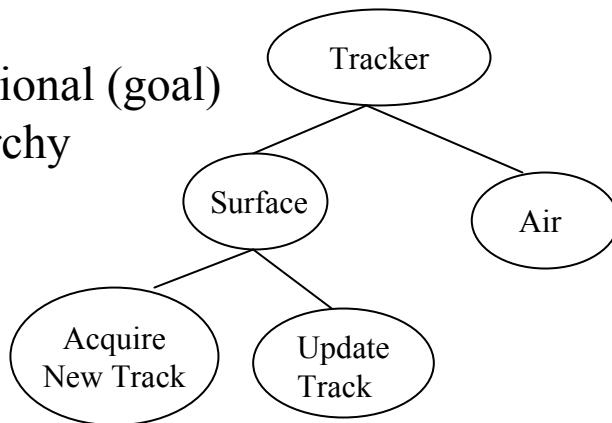


# Understanding the Relation of Mission & Function

## Sample Common Task Analysis Tree



### Functional (goal) hierarchy



# Usefulness of Systems Representation

- To find out what's not broke and what to fix.

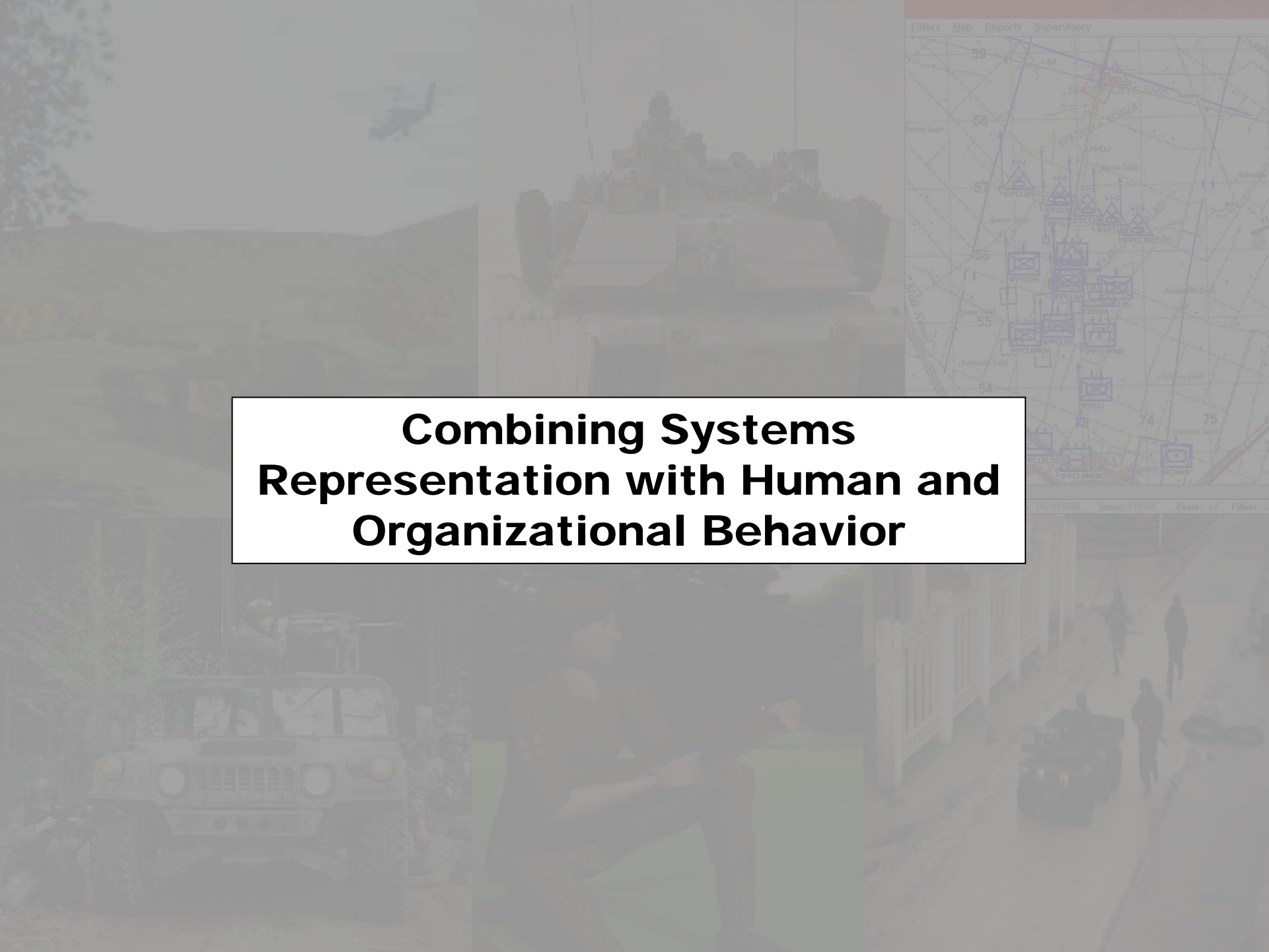
“That’s the way we’ve always done it”

- To discover false assumptions or *‘misrepresentation’*

“The Army’s newest tank crewmembers trying to *Be All that They Can Be*”  
by trying to jump over gullies

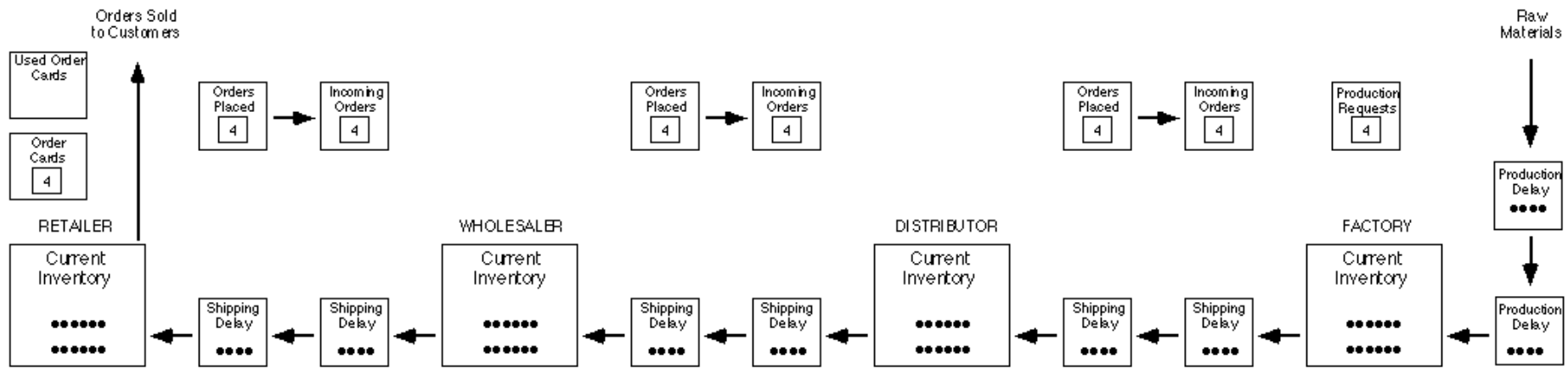
- To take a step back and see the process as it really is.

“Automakers recalling cars made the day after the World Cup!”



# Combining Systems Representation with Human and Organizational Behavior

# The MIT Beer Game Simulation



Source: <http://web.mit.edu/jsterman/www/SDG/beergame.html>

Professor Sterman –Sloan School of Management - MIT

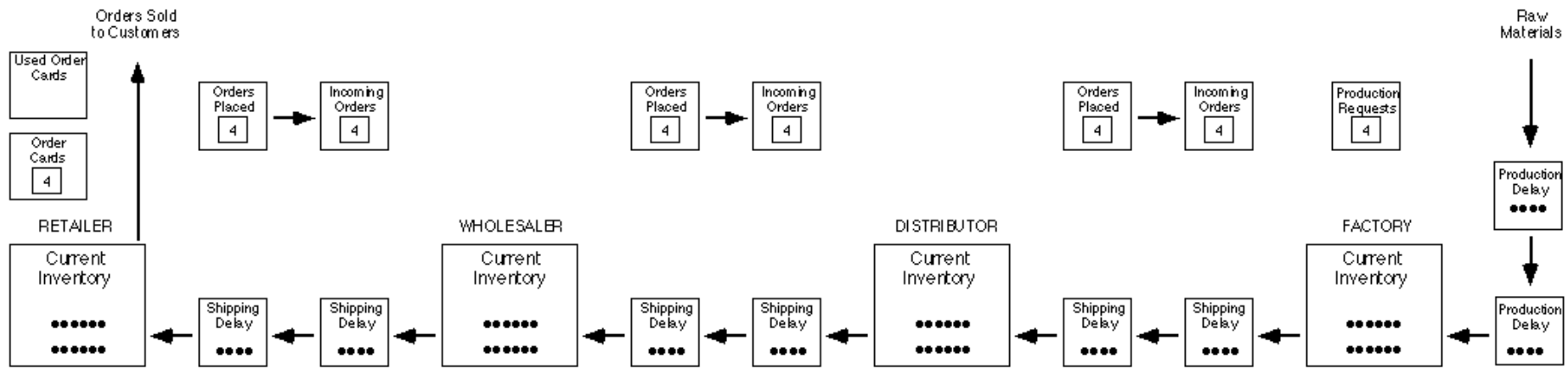
## Rules of Engagement

- Discussion between groups violates the honor code.
- You can store as much as you want but will pay 50 cents per item.
- You can order as much as you want but will pay \$1 per backorder item.
- Orders are two weeks in advance, taking two weeks to arrive.

Source: <http://beergame.mit.edu/>

Permission Granted – MIT Supply Chain Forum 2005

# The MIT Beer Game Simulation



Source: <http://web.mit.edu/jsterman/www/SDG/beergame.html>

Professor Sterman –Sloan School of Management - MIT

## What is the Significance of Representation Here?

Does not look or smell like beer

No truck noise nor the clanging of bottles

A few minutes equals a week

# 'The Tech Bubble'

- The dot-com model of the late 1990s was inherently flawed.
- A vast number of companies had the same business plan of running up debt to capture 'mindshare' and outlasting their opponents.
- Not all could monopolize their sector as planned.
- The few that did were Amazon.com and Yahoo.

## Leading Questions

What was the system?

Why did events occur the way they did?

What would your group have done differently?

Is this common in a military environment?

# Converting Representation to a Military Context

## LZ X-Ray, Ia Drang, Vietnam, November 1965



### Environment

Terrain

Atmosphere

Space

Ocean

### Systems

Units

Weapons

Platforms

Life Support

C4I

### Human Behaviour

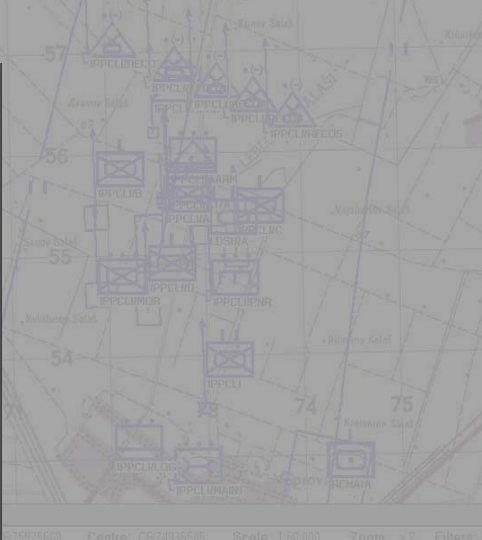
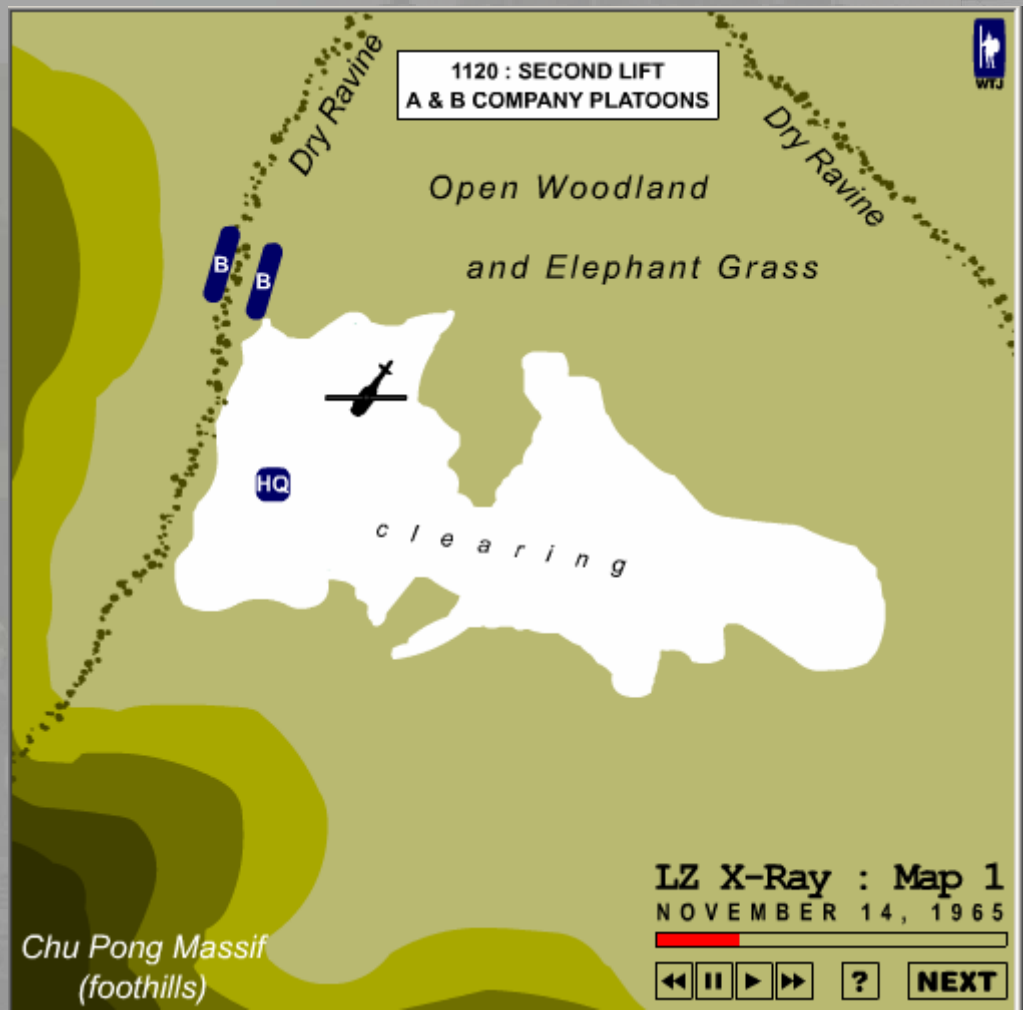
Individual

Crews/Teams

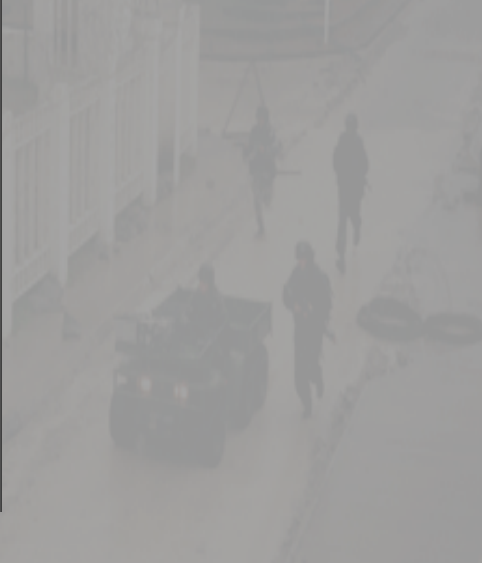
Large Units

Friendly, opposing,  
& neutral forces

# The Difference Between Writing & Representation LZ X-Ray, Ia Drang, Vietnam, November 1965



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# Converting Representation to a Military Context

## LZ X-Ray, Ia Drang, Vietnam, November 1965

### Leading Questions

What was the system?

What was the incomplete information?

Why did events occur the way they did?

What would your group have done differently?

Is this common in the real world?

# Your Key Challenge Using Systems Representation

Training staffs to absorb, process, anticipate and recommend based on *incomplete information*:

- The USS Vincennes, *To Shoot or Not*, Judgment Calls, Mowen, 1993.
- Why groups suppress information, *Groupthink*, Janis, 1971.
- Any BCTP AAR, “*Who Needed to Know?*”, FT Leavenworth.

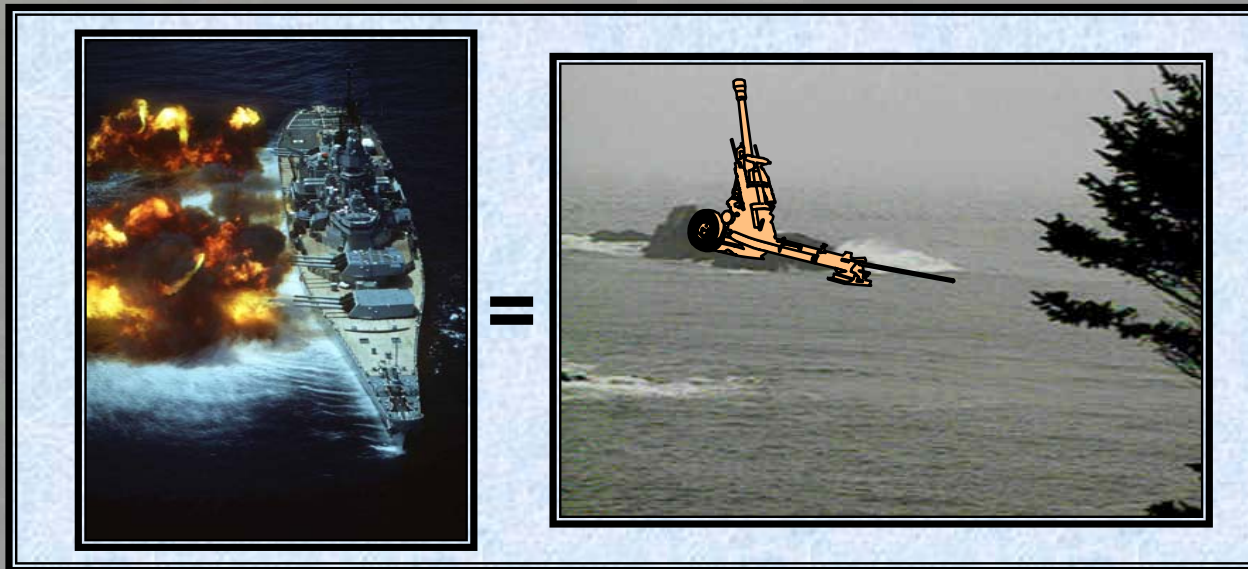
Assumptions drive what *incomplete information* is studied:

- Iraq: Offense, Refugees vs. Supply Convoys, Foreign Fighters
- Afghanistan: Offense, Air Sorties vs. Horse Cavalry, Pursuit

“The key challenge for the United States military in a representational context is they spend most of their training effort on skills they already excel at.”

# Another Challenge is the Limited Ability Of Models to Represent

## Workarounds



**Fidelity issues**

***False design***

***Scripted***

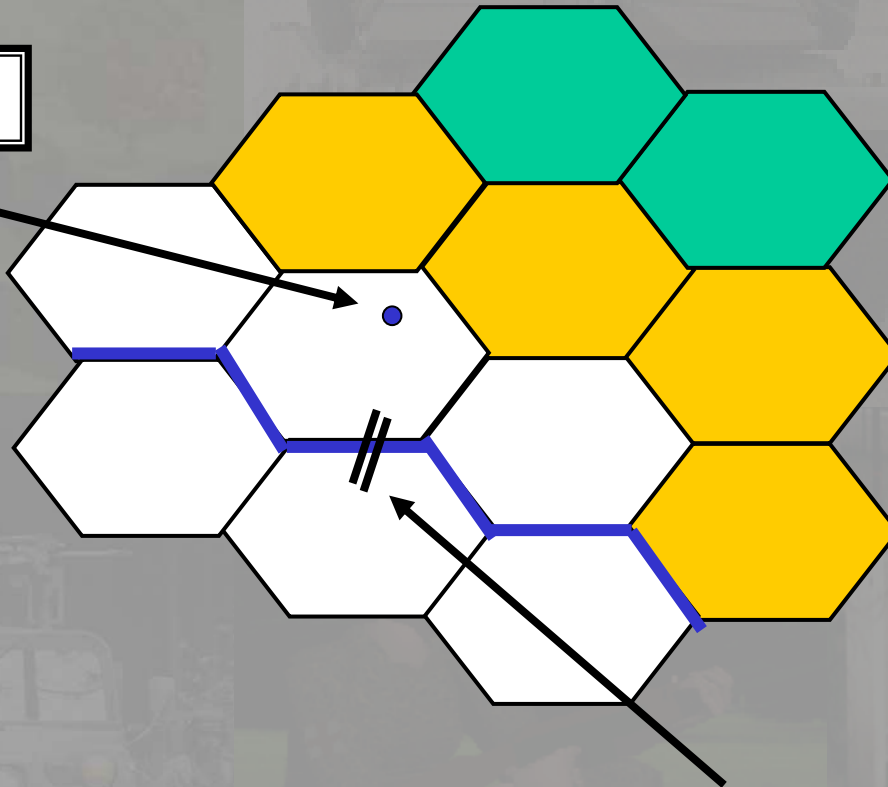
***Ignorance***

It is easier to build an island than a battleship

# Workaround Examples

## Blowing up a Bridge in JTLS

This is the bridge



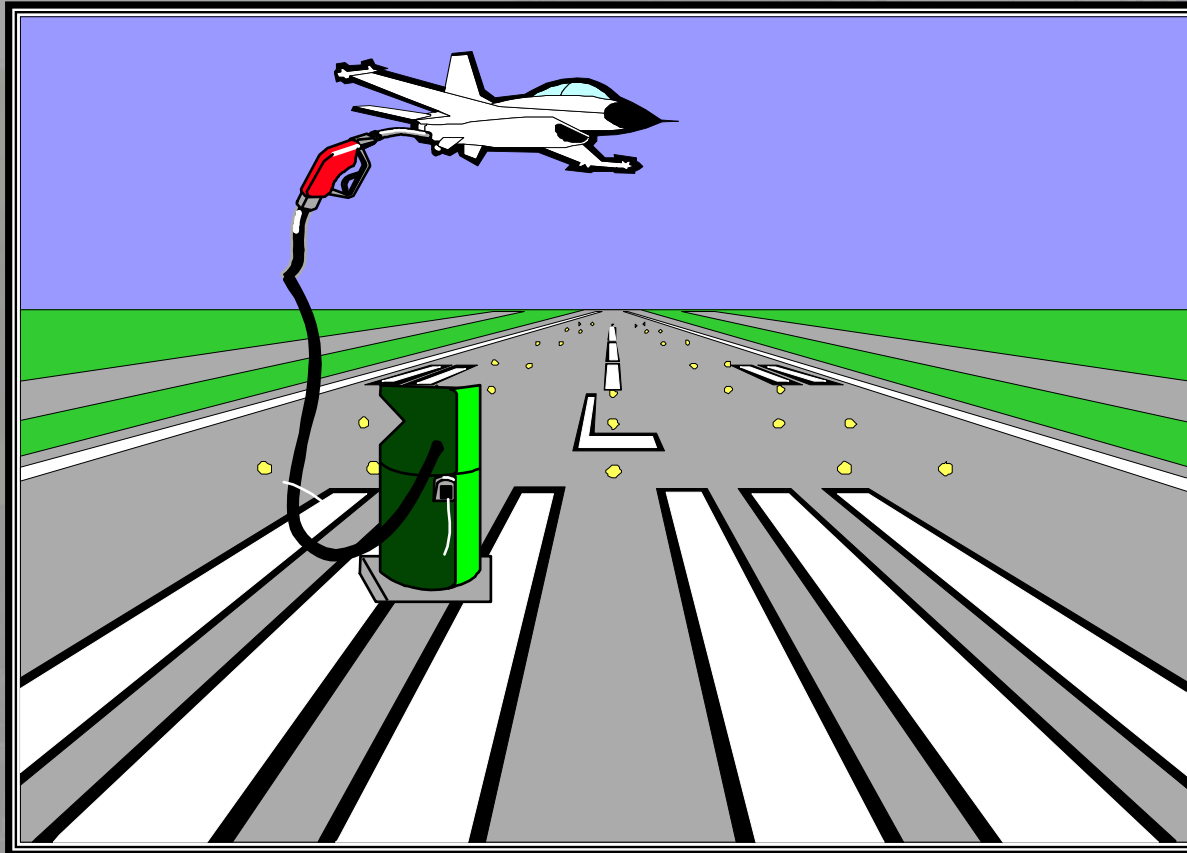
This is what the Air cell bombed without success

# Workaround Examples



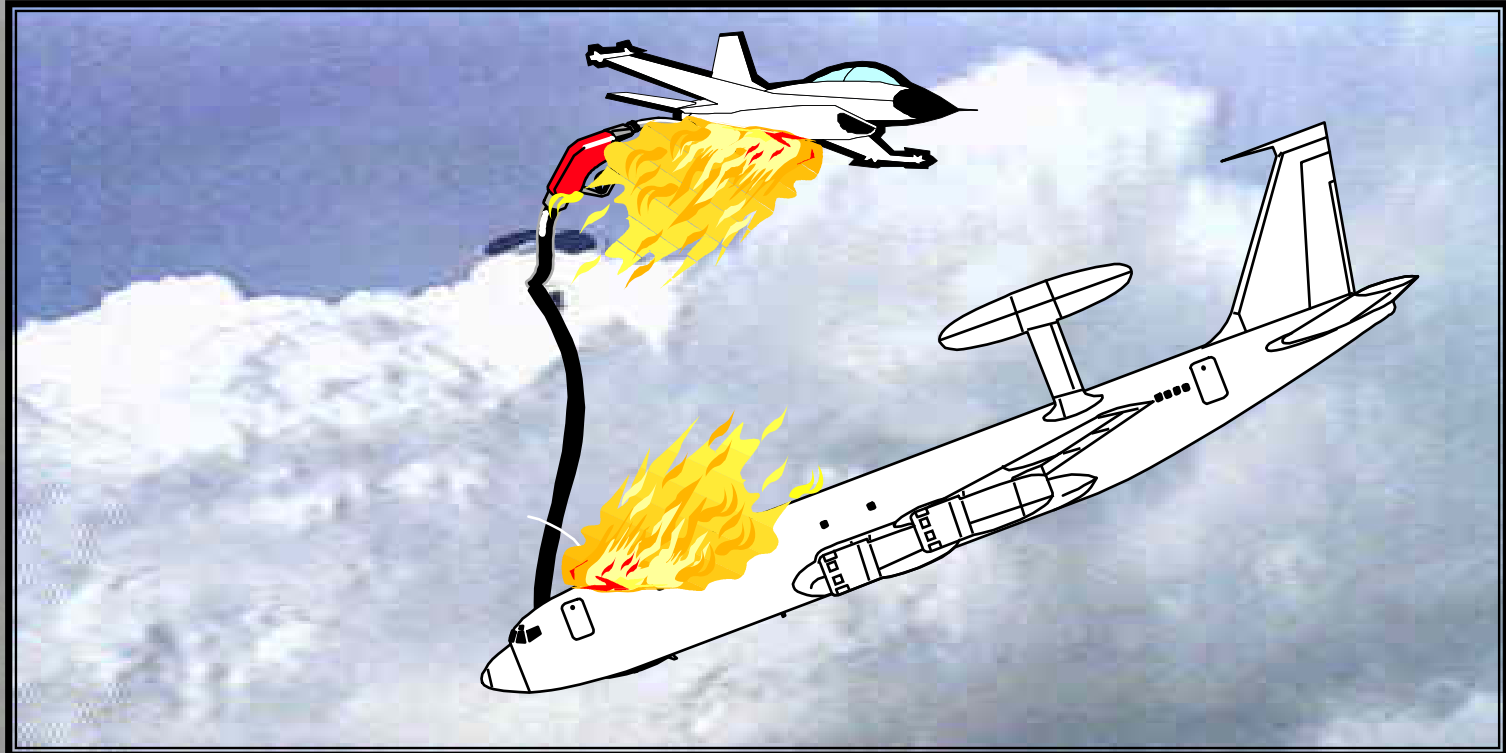
Refueling of aircraft in CBS/AWSIM

# Workaround Examples



Solution: Attach a fuel source from airfield with a long fuel line

# Workaround Examples



Resulted in game crash and 2 aircraft exploded in the middle of a critical offensive operation

# Learning Objectives

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Describe human and organisational behaviour representation.