



**2022**  
Annual **INCOSE**  
international workshop  
**HYBRID EVENT**  
Torrance, CA, USA  
Jan 29 - Feb 1, 2022

Premier Systems Engineering Workshop

# When You Build It and They Do Not Come

Daniel Call, Colorado State University

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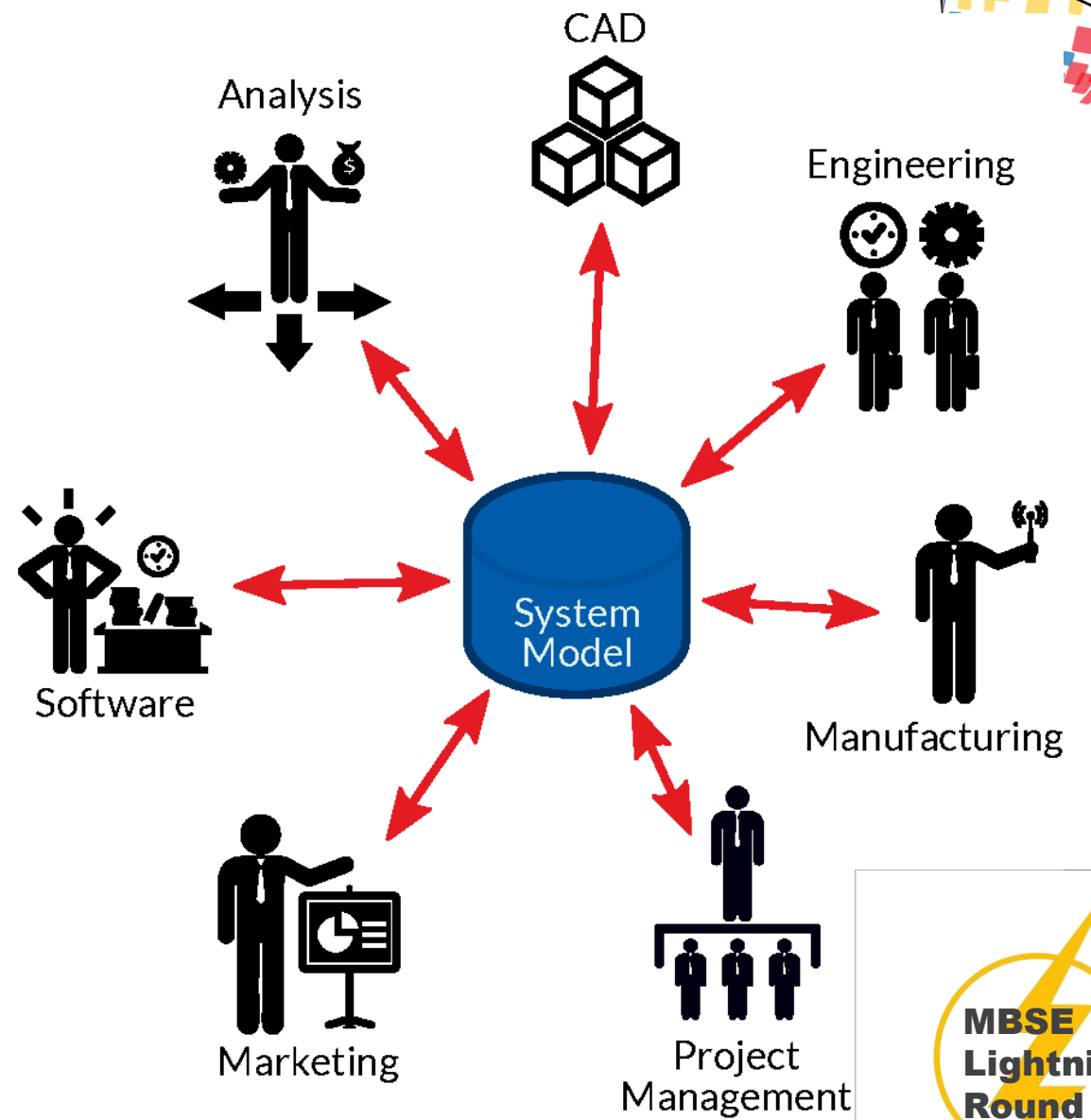
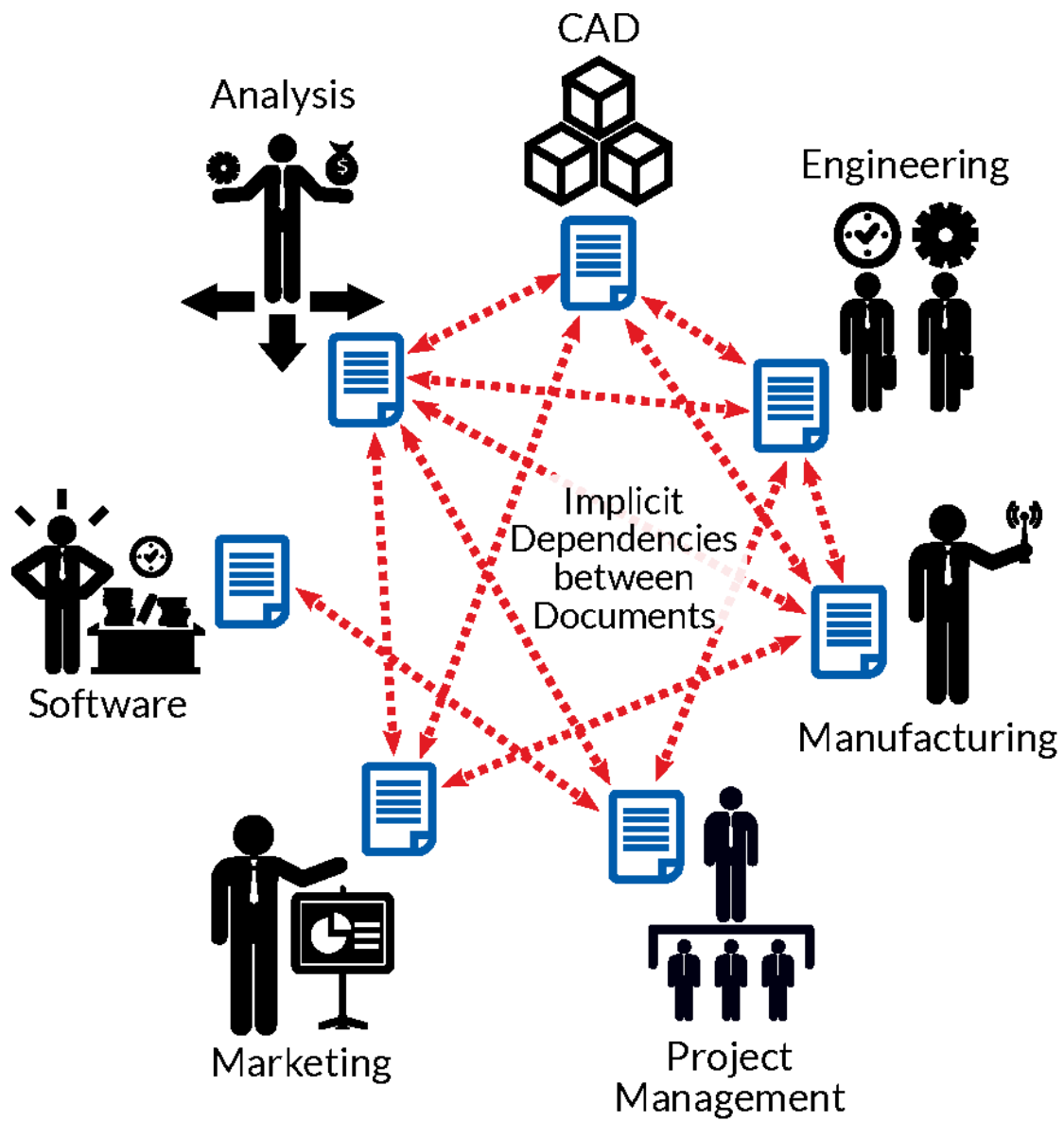


“If you build it, he will come.”

“If you build it, **THEY** will come.”

If you develop and provide the right product or service, the demand and market will materialize, and adoption will occur





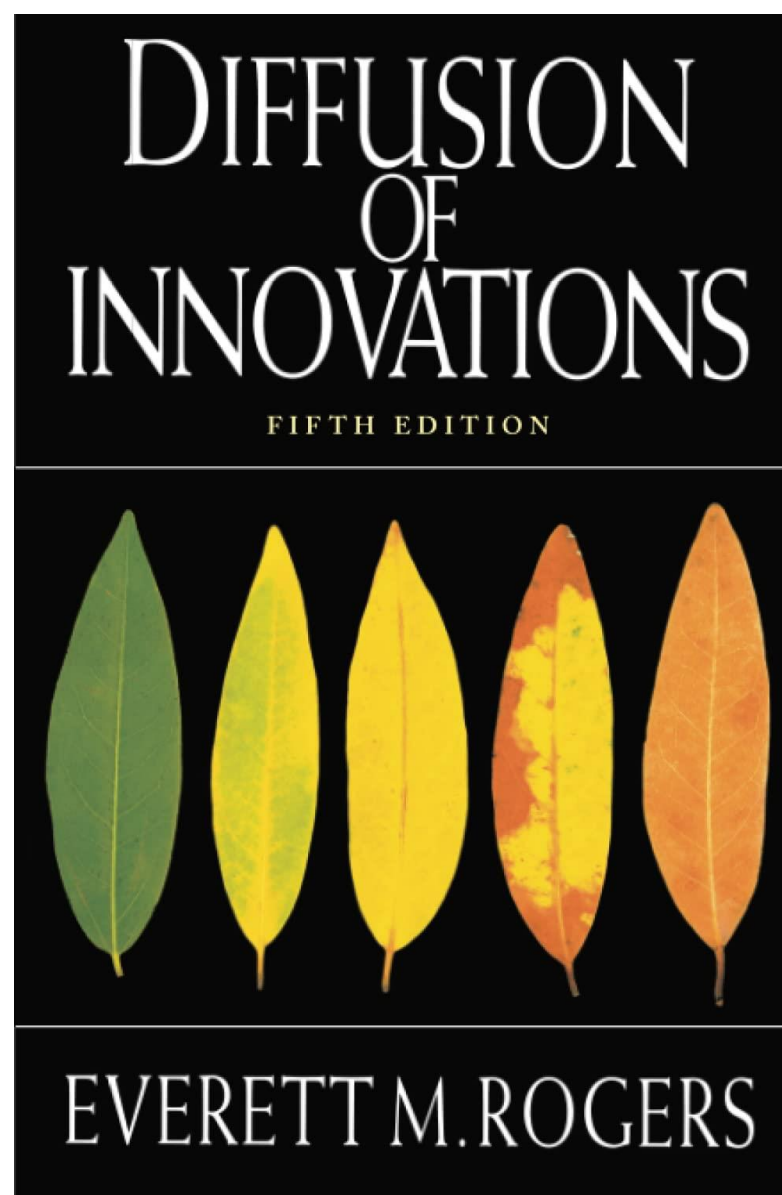


“The study of human interactions, cognitive psychology, social choice theory, and other disciplines must be included in the development of effective theories of system engineering”

-Michael Griffin

Griffin MD. How do we fix system engineering?. *International Astronautical Congress 2010*; 27.

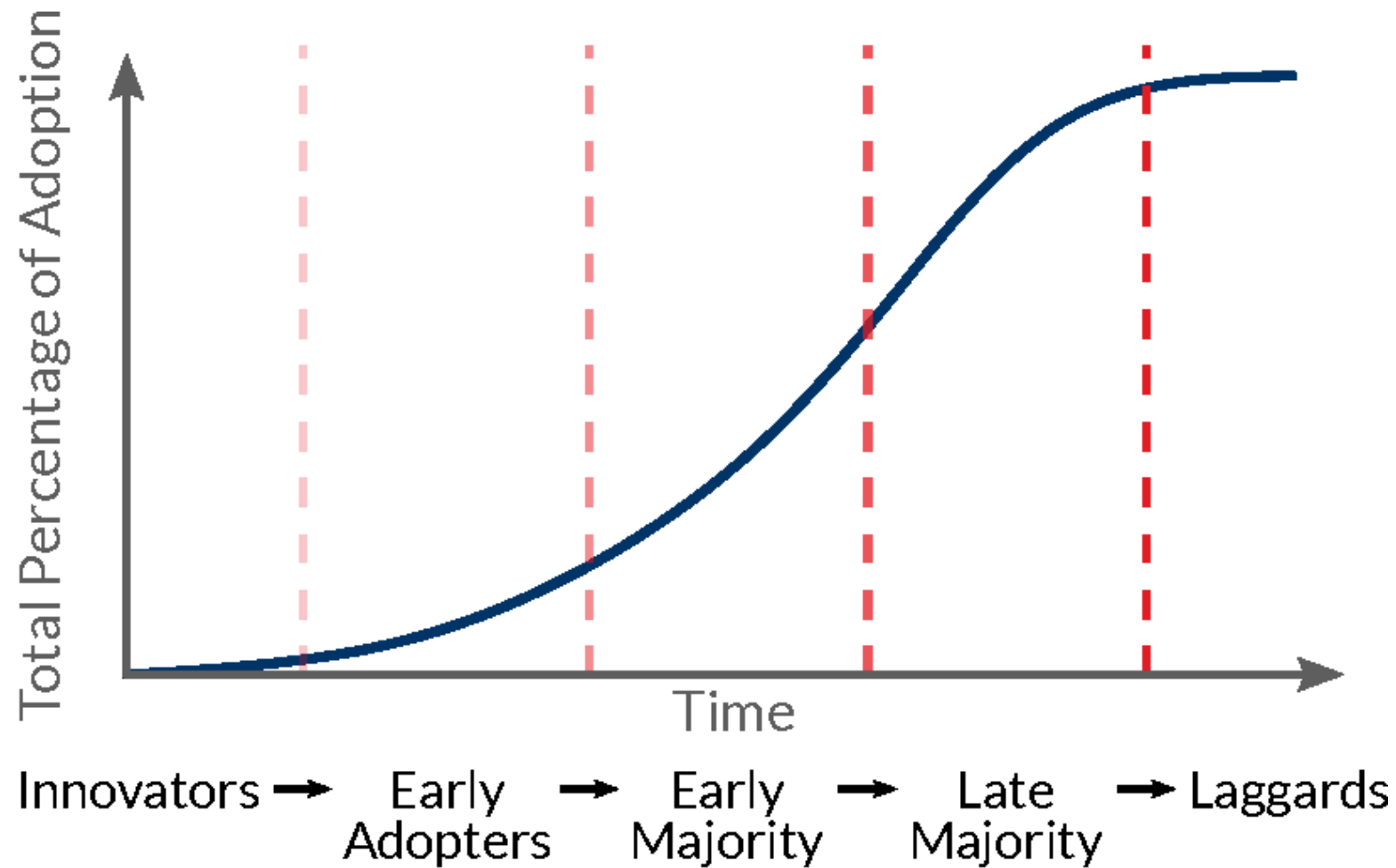




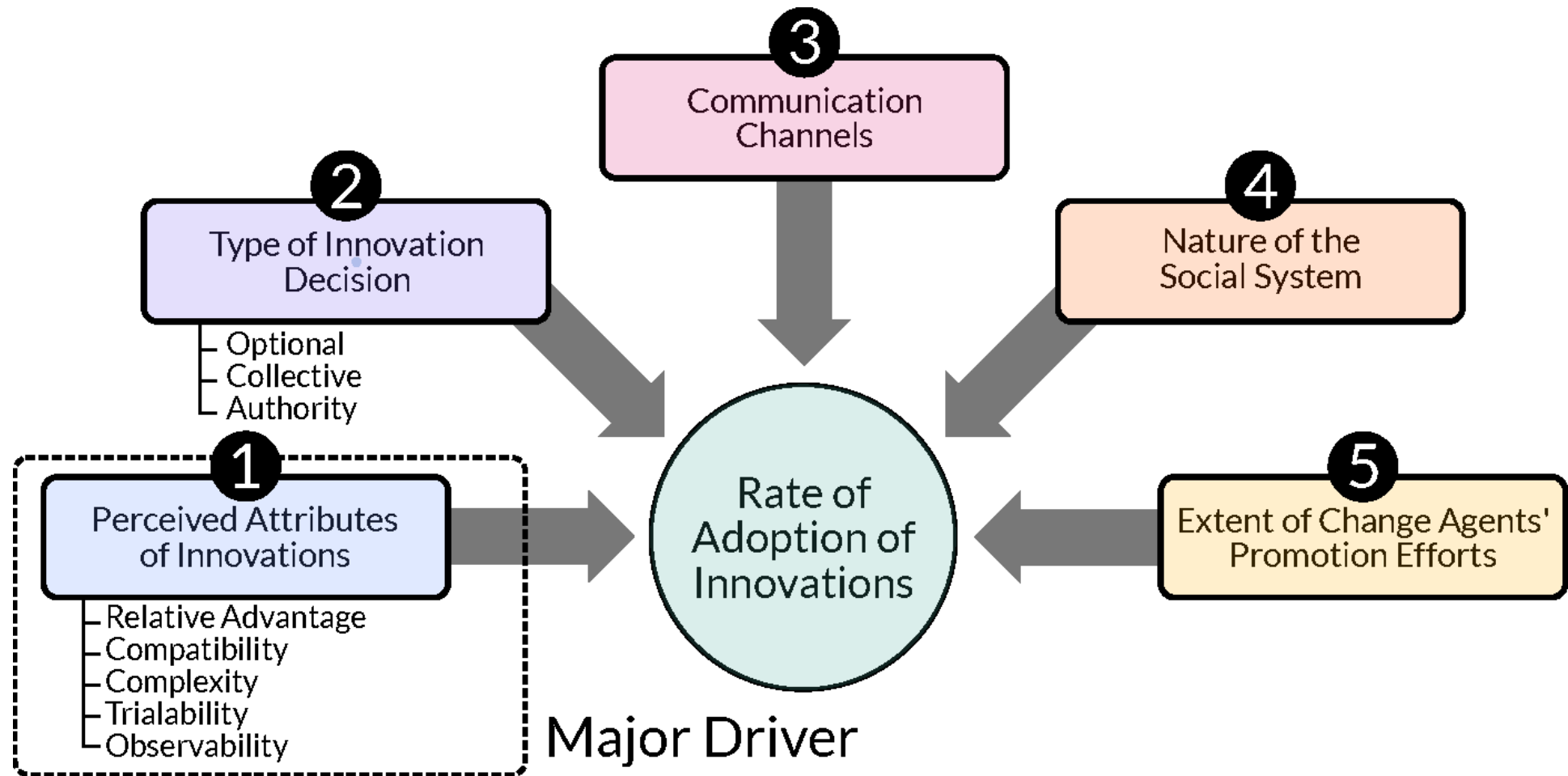
Rogers EM. *Diffusion of Innovations*. Free Press. 5th ed. 2003.



# Generalized Adoption S-Curve



# Variables that affect the rate of adoption of innovations





# Relative Advantage

“The degree to which an innovation is perceived as being better than the idea it supersedes”





# Compatibility

“The degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters”





# Complexity

“The degree to which an innovation is perceived as relatively difficult to understand and use”





# Trialability

“The degree to which an innovation may be experimented with on a limited basis”





# Observability

“The degree to which the results of an innovation are visible to others”



# Failed Adoption

## The Dvorak Keyboard

~	!	@	#	\$	%	^	&	*	(	)	-	=	←
1	2	3	4	5	6	7	8	9	0	-	=	←	Backspace
Tab	Q	W	E	R	T	Y	U	I	O	P	{	}	
↔	↔										[	]	\
Caps Lock	A	S	D	F	G	H	J	K	L	:	"	↵	Enter
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Ctrl	Win Key	Alt							Alt	Win Key	Menu	Ctrl	

(a) QWERTY keyboard layout.

~	!	@	#	\$	%	^	&	*	(	)	{	}	←
1	2	3	4	5	6	7	8	9	0	[	]	←	Backspace
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Ctrl	Win Key	Alt								Alt Gr	Win Key	Menu	Ctrl

(b) Dvorak keyboard layout.





# MBSE Through the Lens of the Diffusion of Innovation Theory



# Relative Advantage



“The degree to which an innovation is perceived as being better than the idea it supersedes”

## Current Perception

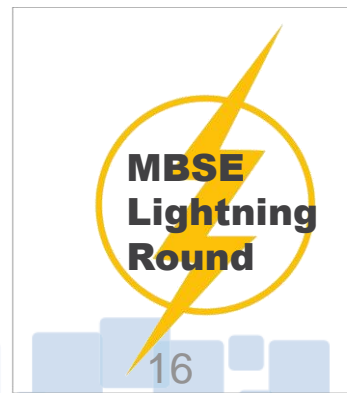
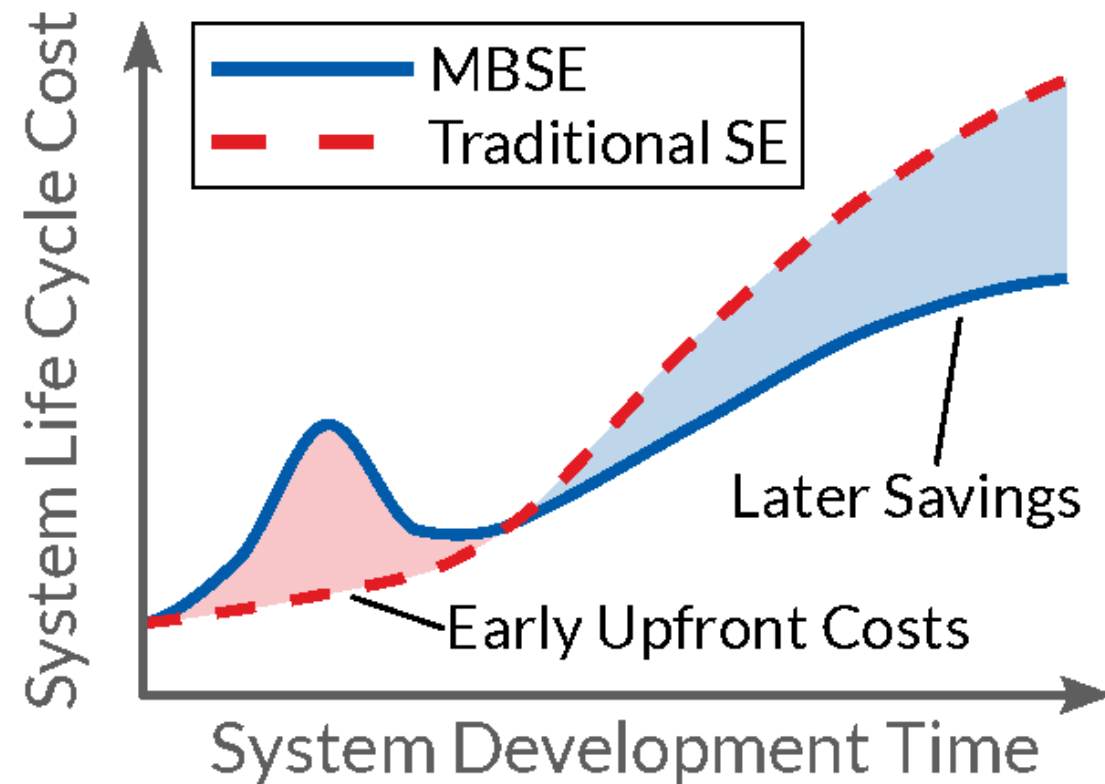
- Early upfront cost hurts the perceived relative advantage

## Opportunities





# Systems Engineering Life Cycle Cost Profile





# Relative Advantage



“The degree to which an innovation is perceived as being better than the idea it supersedes”

## Current Perception

- Early upfront cost hurts the perceived relative advantage
- Preventative innovation

## Opportunities

- Recognition of the upfront cost and improved understanding of lifecycle cost
- Further development of open-source solutions
- Improved design quality metrics



# Compatibility



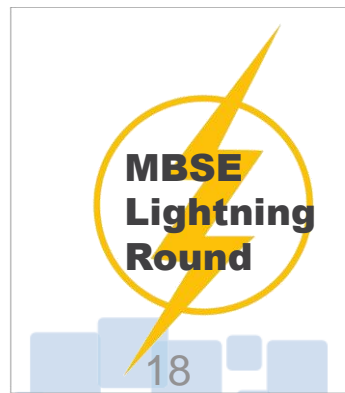
“The degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters”

## Current Perception

- MBSE is new and different
- What need does MBSE meet?

## Opportunities

- Tailor MBSE methodology to existing systems engineering processes
- Focus on the needs that MBSE meets:
  - Enforce consistency
  - Error reduction
  - Authoritative source of truth



# Complexity



“The degree to which an innovation is perceived as relatively difficult to understand and use”

## Current Perception

- HIGH complexity
  - New language, tools, and processes

## Opportunities

- Clear modeling purpose
- Established roles



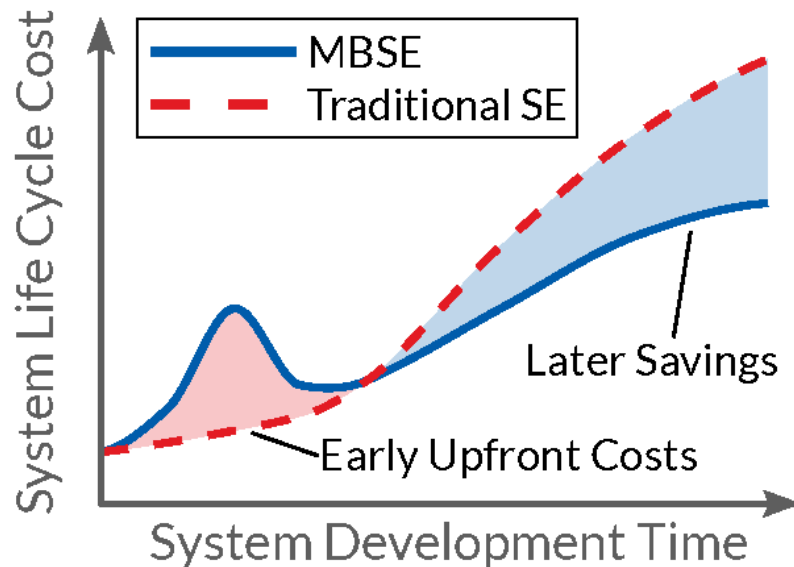
# Trialability



“The degree to which an innovation may be experimented with on a limited basis”

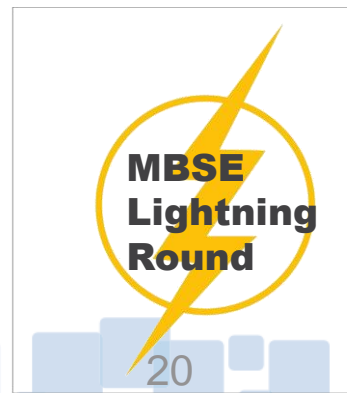
## Current Perception

- All or nothing
- High cost of entry



## Opportunities

- Pilot projects
  - Limited modeling scope
- Further development of open-source solutions
- Utilize tool vendor trial licenses and training



# Observability



“The degree to which the results of an innovation are visible to others”

## Current Perception

- Hard to see problems that are prevented

## Opportunities

- Conduct design reviews and working groups directly from modeling tool
- Improve design quality metrics





# Future Work

- Structured study to determine how MBSE would be evaluated with respect to these attributes in organizations that have successfully adopted, tried and failed to adopt, or are considering adopting MBSE
- Use the results of this study to inform a way forward to shape the perceived attributes of MBSE
- Investigate the other variables (type of innovation decision, communication channels, nature of the social system, extent of change agents' promotion efforts)





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The work presented in this presentation was done in collaboration with Dr. Daniel Herber from Colorado State University. Figures in this presentation were included in the manuscript submitted for publication by Call and Herber entitled “Applicability of the Diffusion of Innovation Theory to Accelerate Model-Based Systems Engineering Adoption.”

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