

The Many Facets of Simulation through a Collection of about 100 Definitions

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ABSTRACT

About 100 definitions of simulation are collected and classified in nine types as a basis for a forthcoming critical review of definitions of simulation.

BACKGROUND

Due to the advent of the modeling and simulation (M&S) discipline in almost all branches of knowledge (Ören, 2009a), the development of its body of knowledge becomes of paramount importance and urgency. In the October 2010 issue of the SCS M&S Magazine, an invitation for the final phases of its preparation was published (Ören and Waite, 2010).

WHAT IS DONE

In this article, about 100 definitions of simulation are compiled from seven types of sources as outlined in Table 1. Table 2 shows the three groups and nine types used to categorize the definitions. Table 3 contains all the quoted definitions listed by type of resources and classified in three groups and further in three types within each of the three groups.

An early compilation of 22 definitions of simulation spanning from 1961 to 1979 was prepared by Pritsker (1979). An interesting linguistic analysis of "simulation" which gives hyponyms (more specific meanings), synonyms, and hypernyms (more general meanings) of simulation can be found at (WordNet 3.0).

Table 1. Categories and types of resources used in collecting the definitions of simulation

Early resources • 1960s and 1970s	13
Defense-related resources • Defense-related M&S dictionaries	9
Civilian resources • Civilian M&S dictionaries	3
• Computer dictionaries	5
• Other professional dictionaries (by disciplines)	22
• General-purpose dictionaries and encyclopedias	35
• Scientists and practitioners	10

Table 2. Three groups and nine types used to categorize the definitions

group	A			B			C		
	experiment	training (experience)	game (experience)	modeling	model implementation / execution	technique	similarity / imitation	pretense / fake	other
type	a1	a2	a3	b1	b2	b3	c1	c2	c3
# entries	24	9	1	12	14	8	19	14	7

PLANS FOR THE FUTURE

A companion article will be published in the July issue of the SCS M&S Magazine (Ören 2011b) to attest the richness of M&S discipline where (1) definitions of simulation will be revisited within a unifying framework documented previously (Ören 2009b, 2010, 2011a) and referring to the nine types identified in Table 2, and (2) a list of over 400 terms representing types of simulation will be given. An ontology-based dictionary for the types of simulation is aimed to be developed later (1) to give their definitions, (2) to identify synonyms, and (3) to list them not only in alphabetical order but also in logical groupings which is the essence of ontology-based dictionaries (Ören, Ghasem-Aghaee, and Yilmaz, 2007).

Simulationists are kindly invited to share their views on any step of this on-going effort of the preparation of a Body of Knowledge index for modeling and simulation (M&S BoK) by sending their views to the Letters-to-Editor section of the SCS M&S Magazine.

Table 3. M&S Definitions

1 From Early Resources: 1960s and 1970s				
1.1	1963	"In the 60's , the term 'simulation' and 'modeling' were used interchangeably as the following quotation taken from the first issue of <u>Simulation</u> shows: 'So, with the power vested in me by the SCi Board of Directors as editor of the Journal, I proclaim the name to be SIMULATION and simulation to mean 'the act of representing some aspects of the real world by numbers and symbols which may be easily manipulated to facilitate their study.'" (McLeod 1963.)" (from Ören, 1979).		b1
1.2	1966	(A general definition): "Simulation is, therefore, essentially a technique that involves setting up a model of a real situation and then performing experiments on the model." (Naylor et al., 1966, p. 2).	a1	
1.3	1966	(A specialized definition–business or economic systems): "Simulation is a numerical technique for conducting experiments on a digital computer, which involves certain types of mathematical and logical models that describe the behavior of a business or economic system (or some component thereof) over extended periods of real time." (Naylor et al., 1966, p. 3).	a1	
1.4	1966	"By environmental simulation I mean the representation of the world in which training is expected to be accomplished." (Moss, 1966, p. 90).	a2	
1.5	1972	"The term <i>simulation</i> , strictly speaking, should be reserved to mean the use of a model to carry out 'experiments' specifically designed to study selected aspects of the <i>simuland</i> , i.e., the real-world or hypothesized system that has been modeled." (McLeod, 1972, p. 3 – from Pritsker 1979).	a1	
1.6	1974	"Computer Simulation can be looked upon as the solution of a set of equations that represent the physical system under study." (Bennett, 1974).		b3
1.7	1975	Simulation: "The process of designing a model of a real system and conducting experiments with this model for the purpose either of understanding the behavior of the system or of evaluating various strategies (within the limits imposed by a criterion or a set of criteria)for the operation of the system." (Shannon, 1975).	a1	
1.8	1975	Simulation: "The technique of solving problems by the observation of the performance, over time, of a dynamical model of the system." (Gordon, 1975, p. 7 – from Pritsker 1979).		b3
1.9	1976	Simulation: "The process of using the Simulation Model* to describe the behavior of a physical system and the method of evaluation of the system." (SCS, 1976). *Simulation Model: "The mathematical model as implemented on the computer." (SCS, 1976).		b2
1.10	1977	"If one looks carefully at human activity, one finds that the use of models and the simulation of activity is ever present, from early childhood to old age. It often appears hidden under such phrases as Let's try the following. We simulate by actions or by thought experiments. In fact, we simulate so much that the distinction between model and reality may become fuzzy at times.' (Bekey, 1977)." (from Elzas, 1980)	a1	
1.11	1977	Computer simulation: "Exercise of a tested and certified COMPUTERIZED MODEL to gain insight about REALITY." (SCS, 1977).		b2
1.12	1978	"Simulation is experimentation with models." (Korn and Wait, 1978).	a1	
1.13	1979	Simulation: "The representation of the dynamic behavior of the system by moving it from state to state in accordance with well-defined operating rules." (Pritsker and Pegden, 1979).		b1

2	From Defense-related M&S Dictionaries			
2.1	1989	Simulation: "A method for implementing a model over time." (DoD M&S Glossary, 1989).		b2
2.2	1996	Simulation: "A method for implementing a model over time. Also, a technique for testing, analysis, or training in which real-world systems are used, or where real-world and conceptual systems are reproduced by a model." (DoDI, 1996).	a2	b2
2.3	1998	Simulation: "The execution over time of models representing the attributes of one or more entities or processes. Human-in-the-Loop simulations, also known as simulators, are a special class of simulations." (NMS-MP, 1998).		b2
2.4	2002	Simulation: "The execution over time of models representing the attributes of one or more entities or processes. There are three basic types: <i>Live Simulation</i> - A simulation involving real people operating real systems. <i>Virtual Simulation</i> - A simulation involving real people operating simulated systems. Virtual simulations inject human-in-the-loop in a central role by exercising motor control skills (e.g. flying an airplane), decision skills (e.g. committing fire control resources to action), or communication skills (e.g. as members of a C4I team). <i>Constructive Model or Simulation</i> - Models and simulations that involve simulated people operating simulated systems. Real people stimulate (make inputs) to such simulations, but are not involved in." (UK-SEMS, 2002)		b2
2.5	2005	Simulation: "A method for implementing a model. It is the process of conducting experiments with a model for the purpose of understanding the behavior of the system modeled under selected conditions or of evaluating various strategies for the operation of the system within the limits imposed by developmental or operational criteria. Simulation may include the use of analog or digital devices, laboratory models, or "testbed" sites. Simulations are usually programmed for solution on a computer; however, in the broadest sense, military exercises and wargames are also simulations." (DAUP, 2005).		b2
2.6	2008	Simulation: "The implementation of a model over time." (NDCF, 2008).		b2
2.7	2009	Simulation: "A method for implementing a model over time. (Non-comprehensive examples: federation, distributed interactive simulation, combinations of simulations)." (DoDI, 2009).		b2
2.8	2010	Simulation: "A method for implementing a model over time." (DoD M&S Glossary, 2010).		b2
2.9	-	Simulation: "The method for implementing a model over time." (ADSG).		b2
3	From Civilian M&S Dictionaries			
3.1	2007	Simulation: "Process of observing the <i>energy interactions</i> of a <i>dynamic system</i> model by <i>simulation</i> using a <i>system model</i> exerted to certain conditions and excitations." (MSSG, 2007)		c3
3.2	-	Simulation: "Something (a game in the context of this class) that attempts to <i>simulate</i> (not duplicate) an actual event or experience." (GD Glossary).	a3	
3.3	-	Simulation: "A real, implemented, or instantiated <u>model</u> ; a situated or embedded <u>model</u> ; a set of actions such that, when executed, affect the environment." (M&S in SB-Dictionary).		b2
4	From Computer Dictionaries			
4.1	1995	Simulation: "1: (computer science) the technique of representing the real world by a computer program; 'a simulation should imitate the internal processes and not merely the results of the thing being simulated" [syn: <u>computer simulation</u>]"		b1
4.2		"2: the act of simulating"		c3
4.3		"3: representation of something (sometimes on a smaller scale) [syn: <u>model</u>]"		b1

4.4		"4: the act of giving a false appearance; 'his conformity was only pretending" [syn: <u>pretense</u> , <u>pretence</u> , <u>pretending</u> , <u>feigning</u>] (die.net – from WordNet (r) 1.7).			c2
4.5	2003	Simulation: "Attempting to predict aspects of the behaviour of some system by creating an approximate (mathematical) model of it. This can be done by physical modelling, by writing a special-purpose computer program or using a more general simulation package, probably still aimed at a particular kind of simulation (e.g. structural engineering, fluid flow). Typical examples are aircraft flight simulators or electronic circuit simulators." (die.net– from The Free On-line Dictionary of Computing (2003-OCT-10)).	a1	b1	
5	From Other Professional Dictionaries				
		Definitions of simulation are collected from dictionaries of the following disciplines: Accounting, Business, Computational Fluid Dynamics, Dentistry, Finance, Human Resources, Investment, Legal, Marketing, Medical, Media, Veterinary			
		Accounting			
5.1		Simulation: "Type of <i>statistical modeling</i> , using a <u>computer</u> , that attempts to mathematically predict the results of an action or series of actions, based on assumptions about how different variables affect each other." (Dictionary of Accounting Terms).	a1	b1	
		Business			
5.2		Simulation: " <u>Acting out</u> or mimicking an <u>actual</u> or probable <u>real lifecondition</u> , <u>event</u> , or situation to find a cause of a past occurrence (such as an <u>accident</u>), or to <u>forecast future effects</u> (outcomes) of assumed circumstances or <u>factors</u> ."			c1
5.3		A simulation may be performed through:		b3	
		(1) solving a set of <u>equations</u> (a <u>mathematical model</u>),			
5.4		(2) constructing a physical (<u>scale</u>) <u>model</u> ,		b1	
5.5		(3) staged rehearsal,			c1
5.6		(4) <u>game</u> (such as wargames), or a <u>computer graphics</u> model (such as an animated <u>flowchart</u>).			c3
5.7		Whereas simulations are very useful <u>tools</u> that <u>allow</u> experimentation without <u>exposure</u> to <u>risk</u> , they are <u>gross</u> simplifications of the reality because they <u>include</u> only a <u>few</u> of the real-world factors, and are only as <u>good</u> as their underlying <u>assumptions</u> ." (Business Dictionary)	a1		
5.8		Simulation: "Attempt to represent a real-life system with a <u>model</u> to determine how a change in one or more variables affects the rest of the system, also called <i>what-if analysis</i> . Simulation will not provide optimization except by trial and error. It will provide comparisons of alternative systems or how a particular system works under specified conditions. It is a technique used for what-if scenarios. The advantages of simulation are: (1) when a model has been constructed, it may be used over and over to analyze different kinds of situations; (2) it allows modeling of systems whose solutions are too complex to express by one or several mathematical relationships; (3) it requires a much lower level of mathematical skill than do <u>optimization model</u> ." (All Business Dictionary)		b3	
		Computational Fluid Dynamics (CFD)			
5.9		Simulation: "The exercise or use of a model. (That is, a model is used in a simulation). (AIAA G-077-1998); For a CFD analysis the application or run of the CFD code is a		b2	

	simulation." (CFD, 2009).			
	Dentistry			
5.10	Simulation: "A mode of computer assisted instruction in which a student receives basic information about a topic and then must interact with the computer to gain deeper understanding of the information and topic. Simulation provides the student with the opportunity to gain experience at limited cost and with reduced risk." (Mosby's Dental Dictionary)	a2		
	Finance			
5.11	Simulation: "The construction of a mathematical model to imitate the behavior of a real-world situation or system in order to test the outcomes of alternative courses of action. Simulation techniques are used in situations where real-life experimentation would be impossible, costly, or dangerous, and for training purposes." (QFinance)	a1 a2		
	Human Resources			
5.12	Simulation: "An imitation of a real life <u>situation</u> for <u>training</u> purposes. Example <i>The simulation exercises for trainee air hostesses include applying first aid treatment to passengers.</i> " (HRDictionary)			c1
	Investment			
5.13	Simulation: "The use of a <u>mathematical model</u> to recreate a situation, often repeatedly, so that the likelihood of various outcomes can be more accurately estimated." (http://www.investorwords.com/4583/simulation.html)			c1
5.14	<i>Monte Carlo</i> Simulation: "A problem solving technique used to approximate the probability of certain outcomes by running multiple trial runs, called simulations, using random variables." (Investopedia)		b3	
	Legal			
5.15	Simulation: "The act of simulating or assuming an appearance that is feigned or not true. It implies the assumption of a false appearance. Criminal simulation is a feigned or fictitious transaction to effect a fraud." (USLegal)			c2
	Marketing			
5.16	Simulation: "Type of <i>statistical modeling</i> , using a <u>computer</u> , that attempts to mathematically predict the results of an action or series of actions, based on assumptions about how different variables affect each other." (Barron's Marketing Dictionary)	a1	b1	
	Media			
5.17	Simulation: "In cultural theory, the way in which a <u>sign</u> or <u>signifier</u> represents some version of reality (Media Dictionary)			c1
	Medical			
5.18	Simulate: "To have or produce a symptomatic resemblance to. Example: lesions <i>simulating</i> leprosy. (Merriam-Webster)			c1
	Signal Processing			
5.19	Simulation: "The process of applying stimuli to a model and producing the corresponding responses from the model (when those responses would occur)." (RTWG. 1995).	a1		
	Veterinary			
5.20	Simulation: "1. imitation of a system such as an ecological or farming system by a series of mathematical formulae.			c1

5.21	2. the act of running a model.		b2	
5.22	3. the imitation of one disease by another."(Saunders Veterinary Dictionary)			c1
6	From General-purpose Dictionaries and Encyclopedias Selections are made from the following sources: Babylon English Dictionary, EWI, M&S Encarta, Merriam Webster, Merriam Webster-learner's Dictionary, OED, Oxford Dictionary of Philosophy, Roget's Thesaurus, Webster, Wikianswers, WordNet. <u>Babylon</u> English Dictionary:			
6.1	Simulation: "act of pretending; imitation, counterfeit; imitation of the operation or features of one system using another system (i.e. computer simulation)"			c2
	<u>English-Word Information:</u>			
6.2	Simulation: "1. The reproduction of the essential features of something; such as, an aid to study or training.	a2		
6.3	2. The imitation or feigning of something or a false appearance. 3. The construction of a mathematical model to reproduce the characteristics of a phenomenon, system, or process, often using a computer.			c2 c1
6.4	4. A computer game which simulates or reproduces a real activity; such as, flying.		b1	
6.5	5. A broad collection of methods used to study and to analyze the behavior and performance of actual or theoretical systems. Simulation studies are performed, not with a real-world system, but on a (usually computer-based) model of the system created for the purpose of studying certain system dynamics and characteristics."	a1		
	<u>MSN Encarta:</u>			
6.6	Simulation: "1. reproduction of features of something: the reproduction of the essential features of something, e.g. as an aid to study or training	a2		c1
6.7	2. false appearance: the imitation or feigning of something			c2
6.8	3. fake: an artificial or imitation object			c2
6.9	4. COMPUT construction of mathematical model: the construction of a mathematical model to reproduce the characteristics of a phenomenon, system, or process, often using a computer, in order to infer information or solve problems.	a1	b1	
6.10	5. COMPUTER GAMES computer game: a computer game that simulates a real activity <i>such as flying</i> "			c3
	<u>Merriam-Webster</u>			
6.11	Simulation: "1. the act or process of simulating			c3
6.12	'2. a sham object : <u>COUNTERFEIT</u> "			c2
6.13	3a. the imitative representation of the functioning of one system or process by means of the functioning of another <acomputer simulation of an industrial process>			c1
6.14	3b. examination of a problem often not subject to direct experimentation by means of a simulating device"	a1		
	<u>Merriam-Webster Learner's Dictionary:</u>			
6.15	Simulation: "something that is made to look, feel, or behave like something else especially	a2		

	so that it can be studied or used to train people [<i>count</i>] —often + <i>of</i> ▪ a computer <i>simulation of</i> spaceflight ▪ <i>simulations of</i> body movements ▪ a <i>simulation of</i> the planet's surface [<i>noncount</i>] computer <i>simulation</i> to predict weather conditions"		
	<u>Oxford Advanced Learner's Dictionary:</u>		
6.16	Simulation: "1 [COUNTABLE, UNCOUNTABLE] a situation in which a particular set of conditions is created artificially in order to study or experience something that could exist in reality. • a computer simulation of how the planet functions • a simulation model • An important part of training is role-play and the simulation of court cases.	a2	
6.17	2 [UNCOUNTABLE] the act of pretending that something is real when it is not • the simulation of genuine concern."		c2
	<u>Oxford Dictionary of Philosophy:</u>		
6.18	Simulation: "The view that our understanding of others is not gained by the tacit use of a 'theory', enabling us to infer what thoughts or intentions explain their actions, but by reliving the situation 'in their shoes' or from their point of view, and thereby understanding what they experienced and thought, and therefore expressed. Understanding others is achieved when we can ourselves deliberate as they did, and hear their words as if they are our own. The suggestion is a modern development of the <u>verstehen</u> tradition associated with <u>Dilthey</u> , <u>Weber</u> , and <u>Collingwood</u> . See also <u>theory-theory</u> ."		c3
	<u>Online Etymology Dictionary:</u>		
6.19	Simulation "mid-14c., "a false show, false profession, "from O.Fr. <i>simulation</i> , from L. <i>simulationem</i> (nom. <i>simulatio</i>) 'an imitating, feigning,' noun of action from <i>simulare</i> 'imitate,' from stem of <i>similis</i> 'like' (see <u>similar</u>)."		c2
6.20	<u>simulate</u> (v.) "1620s (implied in <i>simulated</i>), from L. <i>simulatus</i> , pp. of <i>simulare</i> (see <u>simulation</u>). First record of <i>simulated</i> in sense of 'imitative for purposes of experiment or training' is from 1966 (<i>simulation</i> in this sense dates from 1954)."	a1 a2	
6.21	<u>simulacrum</u> "1590s, from L. <i>simulacrum</i> 'likeness, image, form, representation, portrait,' dissimilated from * <i>simulacrom</i> , from <i>simulare</i> 'to make like' (see <u>simulation</u>). The word was borrowed earlier as <i>semulacre</i> (late 14c.), via O.Fr. <i>simulacre</i> ."		c1
6.22	<u>mockup</u> "also <i>mock-up</i> , 'model, simulation' 1920, from <u>mock</u> (v.). + <u>up</u> ."		c1
6.23	<u>dissimulation</u> "late 14c., from O.Fr. <i>dissimulation</i> (12c.), from L. <i>dissimulationem</i> (nom. <i>dissimulatio</i>) 'a disguising, concealment,' noun of action from pp. stem of <i>dissimulare</i> 'make unlike, conceal, disguise,' from <i>dis-</i> 'completely' + <i>simulare</i> 'pretend, assume, simulate' (see <u>simulation</u>)."		c2
6.24	<u>assemble</u> "mid-13c. (trans.), c.1300 (intrans.), from O.Fr. <i>assembler</i> (11c.), from L. <i>assimulare</i> 'to make like, think like,' later 'to gather together,' from <i>ad-</i> 'to' (see <u>ad-</u>) + <i>simulare</i> 'to make like' (see <u>simulation</u>)."		c1
	<u>Roget's Thesaurus:</u>		
6.25	Simulation: "An inferior substitute imitating an original: <u>copy</u> , <u>ersatz</u> , <u>imitation</u> , <u>pinchbeck</u> . See <u>substitute</u> "		c2

6.26	"A display of insincere behavior: <u>act</u> , <u>acting</u> , <u>disguise</u> , <u>dissemblance</u> , <u>masquerade</u> , <u>pretense</u> , <u>sham</u> , <u>show</u> . See <u>honest/dishonest</u> , <u>true/false</u> ."			c2
	Webster's Revised Unabridged Dictionary			
6.27	Simulation: "1. (computer science) the technique of representing the real world by a computer program; 'a simulation should imitate the internal processes and not merely the results of the thing being simulated' [syn: <u>computer simulation</u>]		b3	
6.28	2. the act of simulating			c3
6.29	3. representation of something (sometimes on a smaller scale) [syn: <u>model</u>]			c1
6.30	4. the act of giving a false appearance; 'his conformity was only pretending' [syn: <u>pretense</u> , <u>pretence</u> , <u>pretending</u> , <u>feigning</u>]			c2
	Wikipedia on Answers.com: (<u>WikiAnswers</u>)			
6.31	"Simulation is the imitation of some real thing, state of affairs, or process. The act of simulating something generally entails representing certain key characteristics or behaviours of a selected physical or abstract system. A simulation is an artificial or illusional version of something. For example, if you create a <u>computer</u> game in which what appears to be a person throws what appears to be a basketball through what appears to be a hoop, you have a simulation of the game of basketball, even though no actual people, basketballs, or hoops are involved."			c1
	WordNet 3.0			
6.32	"1. simulation -- (the act of imitating the behavior of some situation or some process by means of something suitably analogous (especially for the purpose of study or personnel training))			c1
6.33	2. simulation, computer simulation -- ((computer science) the technique of representing the real world by a computer program; 'a <i>simulation</i> should imitate the internal processes and not merely the results of the thing being simulated')		b1	
6.34	3. model, simulation -- (representation of something (sometimes on a smaller scale))		b1	
6.35	4. pretense, pretence, pretending, simulation, feigning -- (the act of giving a false appearance; 'his conformity was only pretending')			c2
7	From Some Scientists and Practitioners			
7.1	1980 Elzas: ". . . for the purpose of this keynote –I center my discussion around the concept that <i>simulation consists of similarity carrying out mathematical similarity studies using computers</i> ."			c1
7.2	1983 Baudrillard Simulation: "It is the generation by models of a real without origin or reality: a hyperreal." "Baudrillard's concept of simulation is the creation of the real through conceptual or "mythological" models that have no connection or origin in reality. The model becomes the determinant of our perception of reality—the real. Homes, relationships, fashion, art, music, all become dictated by their ideal models presented through the media. Thus the boundary between the image, or simulation, and reality implodes (breaks down). This creates a world of hyperreality where the distinctions between real and unreal are blurred." (Hawk).			c1
7.3	1984 Gottfried: "Simulation is an activity whereby one can draw conclusions about the behavior of a given system by studying the behavior of a corresponding model whose cause-and-effect relationships are the same as (or similar to) those of the original system."		a1	

7.4	1988	Aburdene: "Simulation is the process of developing a simplified model of a complex system and using the model to analyze and predict the behavior of the original system."	a1		
7.5	1991	Schreiber "Simulation is just one of the techniques in the field of operations research and management science (OR/MS)"		b3	
7.6	1993	Pooch and Wall: "Though the literature gives many definitions of simulation, this definition (by Shannon, 1993)* seems to encompass the more important aspect of this problem-solving process. Of particular importance is the linking of simulation with the traditional model-building approach to problem solving."		b3	
7.7	1993	Shannon: *"Simulation is the process of designing a model of a real system and conducting experiments with this model for the purpose either of understanding the behavior of the system or of evaluating various strategies (within the limits imposed by a criterion or a set of criteria)for the operation of the system."	a1		
7.8	1995	Ören: Simulation: "goal-directed experimentation with dynamic models."	a1		
7.9	1999	Bedeau: "Simulations are super thought experiments."	a1		
7.10	2003	Birta: "Simulation is goal-directed experimentation with dynamic models."	a1		
7.11	2006	Oden et. al. "The ultimate goal of simulation is to predict physical events or the behaviors of engineered systems."	a1		
7.12	2009	Glutzer "Simulation involves the application of mathematical models using a computer to the study of the underlying physical and chemical processes, and prediction of the behaviour and properties of systems, including natural and artificial materials, flow in liquids and gases, energy at all scales including the cellular level, and biomedical sequelae."	a1		

REFERENCES

(All URLs are visited during March 2011.)

- Aburdene, M.F. (1988). *Computer Simulation of Dynamic Systems*. Wm. C. Brown Publishers, Dubuque, Iowa.
- (ADSG). Australian Defence Simulation Glossary, version 1.0.
- Baudrillard, J. (1983). Simulations (Translated by P. Fauss, P. Patton, and P. Beitchman). Semiotext(e), Inc., Columbia Univ., New York, NY.
- Bedeau, M. (1999). Can unrealistic computer models illuminate theoretical biology: Genetic and

- Evolutionary Computation Conference? (from Korb, 2007)
- Bekey, G.A. (1977). *Models and Reality: Some Reflections on the Art and Science of Simulation*. *Simulation*, 29:5, 161-164.
- Bennett, A.W. (1974). *Introduction to Computer Simulation*. West Publishing Co., St. Paul, MN.
- Birta, L.G. (2003). *The Quest for the Modelling and Simulation Body of Knowledge*. Keynote Presentation at the Sixth Conference on Computer Simulation and Industry Applications, Instituto Tecnológico de Tijuana, Mexico, February 19-21, 2003.

- (CFD, 2009). NASA Computational Fluid Dynamics (CFD) Glossary of Verification and Validation Terms.
- (DAUP, 2005). Glossary of Defense Acquisition Acronyms & Terms, Defense Acquisition University Press. 12th Edition.
- Dictionary of Accounting Terms, 4th edition, by Joel G. Siegel and Jae K. Shim, published by Barron's Educational Series, Inc. (die.net, 1995).
- DoD M&S Glossary. (1989). Glossary of Modeling and Simulation (M&S) Terms.
- DoD M&S Glossary. (2010). Glossary of Modeling and Simulation (M&S) Terms. DoD 5000.59-M.
- (DoDI, 1996). Department of Defense Instruction, Nb 5000.61, Enclosure 2, Definitions, April 29.
- (DoDI, 2009). Department of Defense Instruction, Nb 5000.61, Glossary, Dec. 9, 2009.
- Elzas, M.S. (1980). Simulation and the Process of Change. (Keynote speech). Proceedings of the 1980 Winter Simulation Conf., vol. 2, pp. 3-18.
- (GD Glossary). Game Design Glossary.
- Glotzer, S.C. (2009). Chapter 1 – Introduction. WTEC Panel Report on International Assessment of Research and Development in Simulation-based Engineering and Science. World Technology Evaluation Center, Inc., Baltimore, MD, USA.
- Gordon, G. (1975). The Application of GPSS V to Discrete System Simulation. Prentice-Hall, Englewood Cliffs, New Jersey.
- Gottfried, B.S. (1984). Elements of Stochastic Process Simulation, Prentice-Hall, Englewood Cliffs, New Jersey.
- Korn, G.A. and J.V. Wait (1978). Digital Continuous System Simulation. Prentice-Hall, Englewood Cliffs, New Jersey.
- McLeod, J. (1963). Simulation is What? Simulation, 1:1, 5-6.
- McLeod, J. (1972). Simulation – Today and Yesterday. Simulation, May.
- M&S BoK – M&S Body of Knowledge study (at Ören' website.)
- (M&S in SB-Dictionary). Dictionary of Terms Used in Modeling and Simulation in Systems Biology.
- Moss, E.C. (1966). The Naval Training Device Center Research Program. pp. 88-92. In: Papers Presented at the First Naval Training Device Center and Industry Conference, Nov. 28-Dec. 1, 1966. (Naval Training Device Center, Orlando, FL, 1967) (Later the series became Proceedings of the I/ITSEC)
- MSSG (2007) - Multidisciplinary System Simulation Glossary.
- Naylor, T.H., J.L. Balintfy, D.S. Burdick, and K. Chu (1966). Computer Simulation Techniques. John Wiley & Sons, New York.
- (NDCF, 2008). National Defence and the Canadian Forces, Glossary.
- (NMS-MP, 1998). NATO M&S Master Plan - Part II Definitions, version 1.0 1998, Aug. 7.
- Oden, J.T., T. Belytschko, T.J.R. Hughes, C. Johnson, D. Keyes, A. Laub, L. Petzold, D. Srolovitz, and S. Yip. (2006). Revolutionizing engineering science through simulation: A report of the National Science Foundation blue ribbon panel on simulation-based engineering science. Arlington, VA: National Science Foundation.
- Ören, T. (1979). Concepts for Advanced Computer-Assisted Modelling. In: Methodology in Systems Modelling and Simulation, B.P. Zeigler et al. (eds.). North-Holland, pp. 29-55. (Opening Paper in the Symposium on Modelling and Simulation Methodology, Rehovot, Israel, 1978 August 13-18).
- Ören, T. (1995). Enhancing Innovation and Competitiveness Through Simulation. Preface of the Proceedings of 1995 Summer Computer Simulation Conf., Ottawa, Ont., July 24-26, SCS, San Diego, CA., pp. vi-vii.
- Ören, T.I. (2009a). Uses of Simulation. Chapter 7 in: Principles of Modeling and Simulation: A Multidisciplinary Approach, by John A. Sokolowski and Catherine M. Banks (eds.) (All Chapters by Invited Contributors). John Wiley and Sons, Inc. New Jersey. pp. 153-179.
- Ören, T.I. (2009b). Modeling and Simulation: A Comprehensive and Integrative View. In L. Yilmaz and T.I. Ören (eds.). Agent-Directed Simulation and Systems Engineering. Wiley Series in Systems Engineering and Management, Wiley-Berlin, Germany, pp. 3-36.
- Ören, T.I. (2010). Simulation and Reality: The Big Picture. (Invited paper for the inaugural issue) International Journal of Modeling, Simulation, and Scientific Computing (of the Chinese Association for System Simulation - CASS) by the World Scientific Publishing Co. China, Vol. 1, No. 1, 1-25. DOI: <http://dx.doi.org/10.1142/S1793962310000079>

- Ören, T.I. (2011a). A Basis for a Modeling and Simulation Body of Knowledge Index: Professionalism, Stakeholders, Big Picture, and Other BoKs. SCS M&S Magazine, vol. 2, issue 1 (Jan. 2011), pp. 40-48.
- Ören, T.I. (2011b–submitted). The Richness of the Modeling and Simulation Discipline: Definitions within a Unifying Framework and a List of Nearly 400 Types of Simulation. SCS M&S Magazine, vol. 2, issue 3 (July. 2011).
- Ören, T.I., Ghasem-Aghaee, N., and L. Yilmaz (2007). An Ontology-Based Dictionary of Understanding as a Basis for Software Agents with Understanding Abilities. Proceedings of the Spring Simulation Multiconference (SpringSim'07). Norfolk, VA, March 25-29, 2007, pp. 19-27. (ISBN: 1-56555-313-6.
- Ören, T.I. and B. Waite (2010). Modeling and Simulation Body of Knowledge Index: An Invitation for the Final Phases of its Preparation. SCS M&S Magazine, Vol. 1, issue 4 (October).
- Pooch, U. and J.A. Wall, (1993). Discrete Event Simulation: A Practical Approach, CRC press, Boca Raton, FL.
- Pritsker, A.A.B. (1974). The GASP IV Simulation Language. Wiley & Sons, New York, p. 1.
- Pritsker, A.A.B. (1979). Compilation of Definitions of Simulation. Simulation, 33:2 (Aug. 1979), 61-63.
- Pritsker, A.A.B. and C.D. Pegden (1979). Introduction to Simulation and SLAM. Halsted Press, New York, p. 6.
- (RTWG. 1995). RASSP Taxonomy Working Group. RASSP (Rapid-prototyping of Application Specific Signal Processors) VHDL Modeling Terminology and Taxonomy, revision 1.2, Nov. 20. 1995.
- Schriber, T. (1991). An Introduction to Simulation Using GPSS/H. John Wiley & Sons, Inc., New York, NY
- SCS (1976). The Society for Computer Simulation Definitions of Terms for Analog and Hybrid Computers. Simulation, 26:3 (March), 80-86.
- SCS (1977). Terms and Definitions – "Play it Again, Stew." Text prepared by S. Schlesinger et al. and commented by John McLeod. Simulation in the Service of Society, Simulation, 29:4 (Oct.), vii-ix.
- Shannon, R.E. (1975). System Simulation: The Art and Science. Prentice-Hall, Englewood Cliffs, New Jersey.
- UK-SEMS (2002). Synthetic Environment & Modeling and Simulation, Modeling and Simulation and SE Definitions, Ministry of Defence, The National Archives.
- (WordNet 3.0, 2009). WordNet 3.0 Vocabulary Helper: simulation. POETS (Personalized Online Electronic Text Services) Kyoto Notre Dame University.