

Preface

This short book is a collection of my major researches and projects in the field of command and control from 2004 to 2012. I started my research on the command and control from 2004 at Center for Computational Analysis on Social and Organizational Systems (CASOS), Carnegie Mellon University. My first research of command and control with my advisor, Prof. Kathleen M. Carley, was analyzing the squad team performance in a first-person-shooting game, America's Army. At that time, the US Army was interested in utilizing the game to train soldiers before their deployments. Therefore, measuring how much players gained knowledge about squad teamwork was an important task. My analysis showed pros and cons of using the game as a training simulator. The game did improve players' communication behaviors that imply a better command and control at the squad level. However, some players were not serious in playing the game, and sometimes, the players just throw grenades in front of them to take out many enemies including themselves. This unrealistic behavior gave me fundamental questions: can the modeling and simulation regenerate critical real-world situations? Given that many existing studies utilize the models that are rarely validated, this question of validity still follows my researches and projects.

After my initial research topic with the smallest military unit, I confronted more scenarios that involve larger units with diverse nature. For example, while working at CASOS, I analyzed the command and control of Brigade Combat Team (BCT), and the command and control of various terrorist organizations. These scenarios gained interests because the two organizations shared one common aspect. They have network structures that are not similar to the tree-like hierarchy. Though we formally represent the hierarchical organizational structure of the BCT, the scenarios of interests required dynamics inside of the structure, such as collaboration across branches. At the beginning, I tried to analyze the structure with network analyses, but I found out that the dynamics is difficult to be estimated with the network analyses alone. I needed to regenerate the dynamics, and I also required observing the dynamics in all the aspects with many replications. Subsequently, modeling and simulation became the only option that I can continue my research on command and control. Moreover, this usage of modeling and simulation is particularly called upon when analyzing the opponents. There were limited information and observation chances in the operation of the terror organizations,

so understanding their dynamics necessarily required me to model them with limited knowledge. At this point, I still looked for a possible approach to validate my models. If my model were daily traffic in an urban area, I might be able to validate my model. However, my modeling domain was command and control in an extreme situation, so a dataset that is big enough to attempt the validation was far from the reach. Due to this context, I felt that modeling and simulation should not be the only approach in analyzing these extreme scenarios. Hence, I further studied and applied network mining and text mining techniques to problems at hand. However, these approaches are often difficult to be used in what-if scenario analyses that I should evaluate various strategies to support or attack the structure.

After receiving my doctoral degree in 2008, I came back to Korea to finish my military service. During my service, under Prof. Tag Gon Kim who is another co-author of this book, I was tasked to analyze the fleet naval air defense because Korea just obtained her first AEGIS destroyer. Acquiring the weapon system can be done by budget, but operating the system with human factors takes a long time of experience. Because the system requires a number of human interventions in its operation, the command and control of the destroyer and its fleet is critical in its operational performance. However, as acknowledged in the above, there would be marginal command and control experience unless we deploy the destroyer to diverse situations. Then, until we have gained enough experience and historic data, at least, I had to rely on modeling and simulating the naval air defense operation in the virtual environment. At this time, while I model the command and control, I tried to be more formal, explicit, and transparent. Unless I perform a validation study, this was the least guideline that I had to keep. I started using a formalism to describe my models unambiguously, and I continue to meticulously analyze the virtual experiment result with diverse statistical techniques.

My research has been driven by the practical demand as well as the academic endeavor. The practical demand is analyzing rarely observed scenarios in the intelligence and military field to produce insights that can be applied to the real world. The academic endeavor is performing the analysis with scientific discipline, such as results that can be reproduced by other scientists. I felt that it is very delicate to satisfy both objectives, but I also think that pursuing the objectives at the same time is doable. This book presents three case studies that I struggle to achieve both practicality and scientific rigor. The presented works are completed for now, but through my research, I hope to find a better way to analyze and contribute.

This book is supported by the Public welfare and safety research program through the National Research Foundation of Korea (NRF), (2012-0029881).

Daejeon, Republic of South Korea

Il-Chul Moon

Modeling and Simulating Command and Control
For Organizations Under Extreme Situations

Shin, S.-J.; Carley, K.M.; Kim, T.G.

2013, IX, 87 p. 33 illus., 4 illus. in color., Softcover

ISBN: 978-1-4471-5036-7