Stevens Institute Series on Complex Systems and Enterprises

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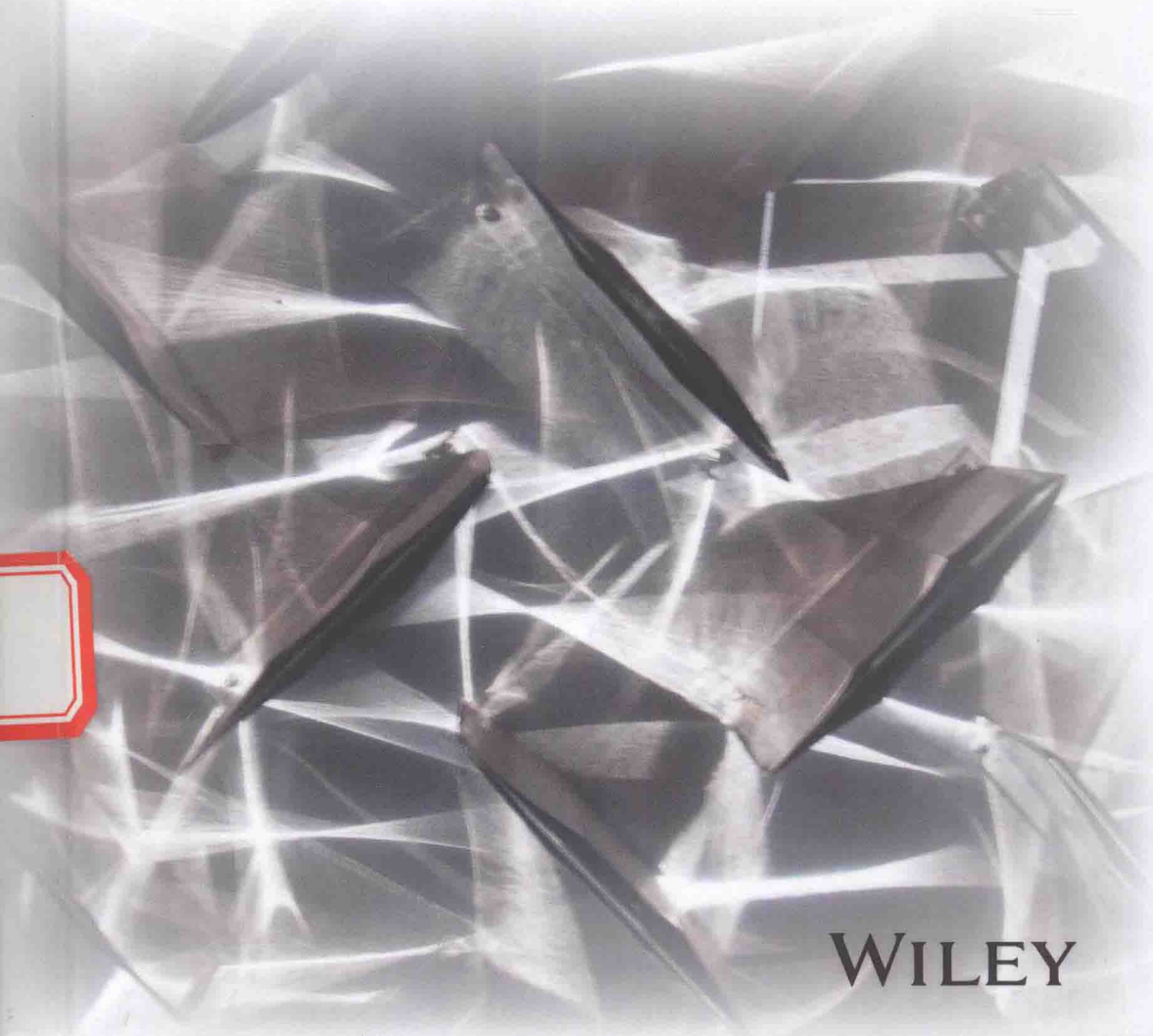
UNIVERSITIES AS COMPLEX ENTERPRISES

How Academia Works, Why It Works These Ways, and Where the University Enterprise Is Headed

William B. Rouse



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Published by John Wiley & Sons, Inc., Hoboken, New Jersey
Published simultaneously in Canada

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Library of Congress Cataloging-in-Publication data applied for

ISBN: 9781119244875

Printed in the United States of America

10 9 8 7 6 5 4 3 2 1

PREFACE

I first entered academia in 1965, over 50 years ago, as a freshman at the University of Rhode Island. Since then, I have served on the faculties of five universities in the United States and Europe, participated on advisory boards of numerous universities, been a consultant to several universities and, overall, been involved with over 50 universities globally. This has resulted in a wealth of fascinating, enlightening, and sometimes frustrating experiences. The intellectual community is often captivating, while the rigidity and resistance to change are sometimes daunting. This book tells the story of those experiences, woven into more expository material on a thousand years of academic organizations. This book also provides the basis for projecting where this fascinating and frustrating enterprise is headed.

A few years ago, I led a graduate course on "transforming academia." The class included eight PhD students and four faculty members. We explored the historical roots of universities and contemporary challenges for academia. The students led this exploration. I organized the syllabus and compiled resource materials, but the PhD students each gave two lectures, all of which were followed by a usually intense discussion. The course culminated with the students presenting to the president and provost their recommendations for how Georgia Tech should strategically think about the future. This presentation was scheduled for 1 hour, but the meeting stretched to 2 hours due to the many questions and much discussion. The findings of this semester-long exploration are laced throughout this book.

I have been involved in many strategic planning activities at numerous universities, either as a faculty member or as a paid consultant. In my most recent engagement, several senior administrators asked, "What shall we assume about the future?" Discussing this question quickly led to the conclusion that any specific prediction would likely be wrong. Consequently, I developed four scenarios for the future of

academia that are discussed in this book. The faculty embraced these scenarios as good portrayals of alternative futures. Subsequently, all the planning teams were asked to assess the merits of their plans relative to each of the four scenarios. They struggled with this assignment and invariably ended up focusing on what could be called "business as usual on steroids." When asked why they ignored the other three scenarios, they responded that they did not know how to think about such different views of academia. They were stuck.

Academic enterprises do seem to be stuck. Increases in the costs of higher education have completely outstripped inflation. Academia has become the poster child for runaway costs, replacing healthcare, which now seems more or less under control. This book explores the nature of academic enterprises, including why they work the way they do and where such enterprises are headed. The goal, however, is not prediction. Instead, the objective is insights into where change can and will happen.

Many people have helped me in my exploration of academia over many decades. My experience at MIT was and continues to be mentored by Dick Larson, Joel Moses, and Tom Sheridan and the late Chuck Vest. My brief experience at Tufts was benefited by the expertise of Percy Hill. My mentors at Illinois were B.T. Chao, Bob Chien, Dan Drucker, and Helmut Korst. My one year in Delft changed my life—I am indebted to Henk Stassen and more recently Theo Toonen. Two stops at Georgia Tech provided many mentors—Jean-Lou Chameau, Wayne Clough, Steve Cross, Rich DeMillo, Don Giddens, Paul Griffin, John Jarvis, Leon McGinnis, Mike Thomas, and John White. Mentors at Stevens have included Tony Barrese, Michael Bruno, Ralph Giffin, Nariman Farvardin, George Korfiatis, and Dinesh Verma. Other colleagues related to singular experiences rather than long-term appointments. These included Berkeley (Lee Schruben), Carnegie Mellon (Duane Adams), Case Western Reserve (Simon Ostrach), George Mason (Andy Sage), Georgetown (Spiros Dimolitsas), Kassel (Gunnar Johannsen), North Carolina State (Paul Cohen and Ed Fitts), Penn State (Paul Griffin), Stanford (Elisabeth Pate-Cornell), Tsinghua (Gavriel Salvendy), Tokyo Institute of Technology (Kinji Mori), and the University of California at San Diego (Hal Sorenson). Opportunities are required to create experiences, and I am indebted to these many colleagues for providing me such a rich set of experiences.

William B. Rouse
Weehawken, NJ
November 2015

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INTRODUCTION AND OVERVIEW

Higher education has become the "poster child" for out-of-control costs, replacing healthcare, which now seems more or less under control. Tuition increases have far outpaced increases of the overall cost of living. This is due to the relative decline of public support for higher education, while administrative costs have been steadily growing much faster than the costs of teaching and research. A primary enabler and consequence of this cost growth has been student debt levels that exceed the total credit card debt in the United States.

We need to get a grip on the economics of higher education, with a goal of transforming the system to improve the overall value proposition. Academia provides a wide variety of offerings that serve a diverse mix of constituencies. Delivery processes for these offerings can be quite creative but are often burdened with inefficiencies. This is complicated by academic governance processes, which can be overwhelming, more so when the university is also a public sector agency. Yet, universities are basically well-intentioned, creative, and committed. There is much to build on but nevertheless much to overcome.

Figure 1.1 depicts a multilevel architecture of academic enterprises (Rouse, 2015). The practices of education, research, and service occur in the context of processes, structure, and ecosystem. Understanding the relationships among practices, processes, structure, and ecosystem provides the basis for transforming academia, leveraging its strengths, and overcoming its limitations. In this book, I explicitly address these relationships in terms of both conceptual and computational models of academic enterprises.

Universities as Complex Enterprises: How Academia Works, Why It Works These Ways, and Where the University Enterprise Is Headed, First Edition. William B. Rouse.
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The architecture in Figure 1.1 helps us to understand how various elements of the enterprise system either enable or hinder other elements of the system, all of which are embedded in a complex behavioral and social ecosystem. Practices are much more efficient and effective when enabled by well-articulated and supported processes for delivering capabilities and associated information, as well as capturing and disseminating outcomes.

Processes exist to the extent that organizations (i.e., campuses, colleges, schools, and departments) invest in them. These investments are influenced by economic models and incentive structures and are made in pursuit of competitive positions and economic returns. These forces hopefully coalesce to create an educated and productive population, at an acceptable cost.

When we employ Figure 1.1 to understand relationships among universities, the interesting phenomenon in Figure 1.2 emerges. The hierarchical structure of Figure 1.1 dovetails with the heterarchical nature of academic disciplines. The dotted rectangle in Figure 1.2 represents how faculty disciplines both compete and define standards across universities.

The disciplines define the agenda for "normal" science and technology, including valued sponsors of this agenda and valued outlets for research results. Members of faculty disciplines at other universities have an enormous impact on promotion and tenure processes at any particular university. Such professional affiliations also affect

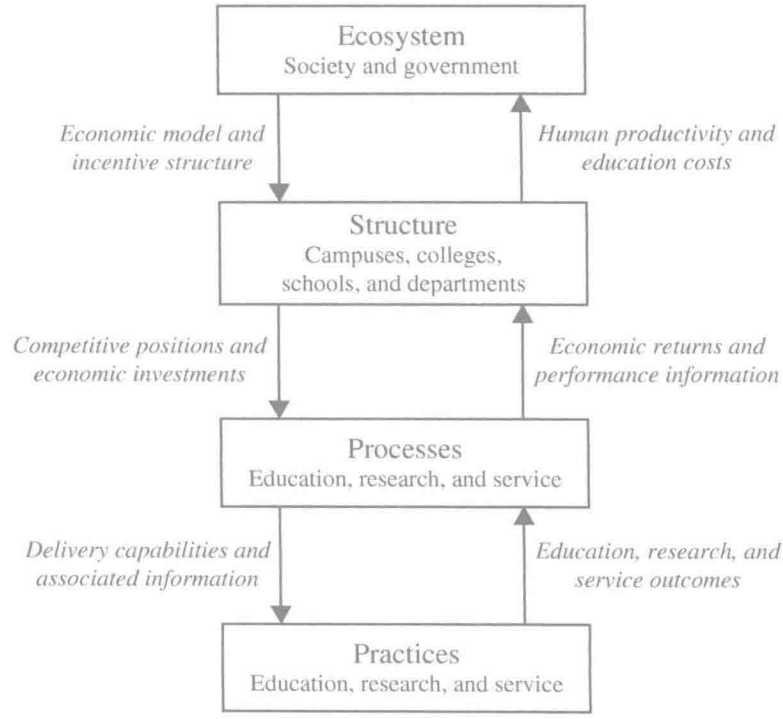

FIGURE 1.1 Multilevel architecture of academic enterprises.

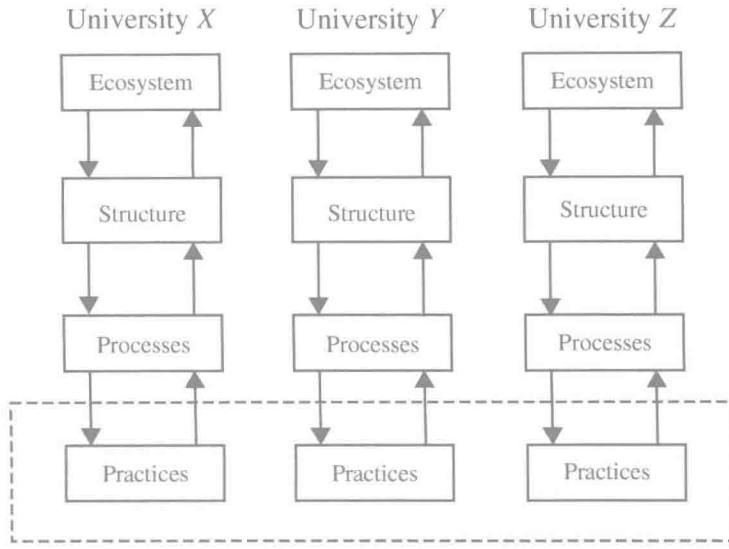

FIGURE 1.2 Hybrid multilevel architecture of academia.

other types of enterprises (e.g., healthcare). However, universities seem to be the only enterprise that allows external parties to largely determine who gets promoted and tenured internally. This has substantial impacts on understanding and modeling the performance of any particular university.

More specifically, the standards set at the discipline level determine:

- Agenda for "normal" science and technology
- Valued sponsors of this agenda
- Valued outlets for research results

Consequently, almost everyone chases the same sponsors and journals, leading to decreasing probabilities of success with either. In addition, each faculty member produces another faculty member every year or so, swelling the ranks of the competitors. Recently, retirements are being delayed to refill individuals' retirement coffers, which decrease numbers of open faculty slots.

As probabilities of success decrease, faculty members write an increasing number of proposals and submit an increasing number of journal articles, resulting in constantly increasing costs of success and congested pipelines, which foster constantly increasing times until success. Bottom line is less success, greater costs, and longer delays. The models discussed in this book enable exploration of these phenomena.

Universities can hold off these consequences by hiring fewer tenure-track faculty members, that is, using teaching faculty and adjuncts. But this will retard their march up the rankings and hence slow the acquisition of talented students, who will succeed in life and later reward the institution with gifts and endowments. The trade-off between controlling cost and enhancing brand value is explored in this book.

Alternatively, universities can pursue "niche dominance" and only hire tenure-track faculty in areas where they can leapfrog to excellence. This will, unfortunately, result in two classes of faculty—those on the fast track to excellence and those destined to teach a lot. The first class will be paid a lot more because of the great risks of their being attracted away to enhance other universities' brands.

OVERALL APPROACH

Many contemporary commentators have made similar observations to those offered in this introduction, although with less emphasis on the structure and processes of the enterprise. For example, Lombardi (2013) provides an exposition of the basic blocking and tackling of academia, primarily from a more general perspective than science and technology. This is relevant in terms of the nature of academic guilds portrayed and the multilevel nature of governance. He also provides a useful discussion of performance and quality management. However, his book does not articulate an overall enterprise perspective.

Christenson and Eyring (2011) explore how universities can find innovative, less costly ways of performing their uniquely valuable functions and thereby save themselves from decline. The authors outline the history of Harvard University and how various aspects of academia were defined by Harvard leadership in response to issues and opportunities of the times. They explore the strategic choices and alternative ways in which traditional universities can change to ensure their ongoing economic vitality. They emphasize the need for universities to address key trade-offs and make essential choices as they decide how to compete.

DeMillo (2011) addresses the challenges faced by "the middle," the 2000 universities that are not part of the "elite"—those with $1 billion plus endowments—and also face stiff competition from for-profit online universities. Computer-based and online technologies, such as MOOCs, and new student-centric business models are discussed. The book culminates in 10 rules for twenty-first-century universities, expressed in terms of defining value and becoming an architect of how this value is delivered. Some of the ideas presented are very relevant to the issues addressed in this book.

These three books are representative of a vast literature on higher education. Many other sources are referenced throughout this book as specific issues are discussed. This book leverages and integrates this material in the following ways:

- The university is viewed as an enterprise system competing in a complex economic, political, and social environment where both competition and collaboration are prevalent
- Examples are drawn from a broad range of experiences with over 50 university enterprises in the United States, Europe, Asia, Africa, and Latin America
- A multilevel architectural view of universities as enterprises enables identifying interactions and opportunities across levels of this architecture, including both avenues and barriers to fundamental change

I address university enterprises both qualitatively and quantitatively. Qualitative expositions draw from history, public policy, economics, etc. Many, but not all, of these expositions set the stage for quantitative models of the phenomena of interest. The quantitative models are valuable for addressing various "what-if" questions discussed in this book.

Examples of such models include use of the enterprise architecture in Figures 1.1 and 1.2 for computational modeling of enterprise performance and economic models of key trade-offs such as the mix of tenure-track versus nontenure-track faculty members. Discounted cash flow models are employed to reflect the time value of money involved in such decades-long investments.

Another example is statistical models of the dynamics of the *US News & World Report* ranking system, in particular time series models of the lags in ranking changes following university investments in faculty, facilities, and other strategic investments. There is a frequently expanding range of university ranking systems, for example, *Financial Times* World University Rankings and Shanghai Jiao Tong University Academic Ranking of World Universities. The various ranking schemes are contrasted in terms of purpose and attributes.

UNIVERSITIES AS COMPLEX SYSTEMS

Universities certainly seem complex—so many stakeholders, agendas, and often conflicting priorities. What type of complex system is a university or, more broadly, universities collectively? They certainly are not similar to airplanes, factories, and process plants, all of which were engineered to achieve specified objectives. They are a subset of the society in general, but they do not seem as complex as the overall society.

Snowden and Boone's (2007) Cynefin Framework includes simple, complicated, complex, and chaotic systems. Simple systems can be addressed with best practices. Complicated systems are the realm of experts. Complex systems represent the domain of emergence, as discussed in the following text. Finally, chaotic systems require rapid responses to stabilize potential negative consequences.

The key distinction with regard to the discussions in this book is complex versus complicated systems—simple certainly is not warranted and we hope to avoid chaotic. There is a tendency, Snowden and Boone contend, for experts in complicated systems to perceive that their expertise, methods, and tools are much more applicable to complex systems than is generally reasonable.

Poli (2013) also elaborates the distinctions between complicated and complex systems. Complicated systems can be structurally decomposed. Relationships can be identified, either by decomposition or in some cases via blueprints. "Complicated systems can be, at least in principle, fully understood and modeled." Complex systems, in contrast, cannot be completely understood or definitively modeled. He argues that biology and all the human and social sciences address complex systems.

Poli also notes that problems in complicated systems can, in principle, be solved. The blueprints, or equivalent, allow one to troubleshoot problems in complicated

systems. In contrast, problems in complex systems cannot be solved in the same way. Instead, problems can be influenced so that unacceptable situations are at least partially ameliorated.

These distinctions are well taken. Complicated systems have often been designed or engineered. There are plans and blueprints. There may be many humans in these systems, but they are typically playing prescribed roles. In contrast, complex systems, as they define them, typically emerge from years of practice and precedent. There are no plans and blueprints. Indeed, much research is often focused on figuring out how such systems work. Good examples are human biology and large cities.

COMPLEX ADAPTIVE SYSTEMS

The nature of human and social phenomena within complex systems is a central consideration. Systems where such phenomena play substantial roles are often considered to belong to a class of systems termed complex adaptive systems. This class of systems includes healthcare delivery (Rouse, 2000, 2008), urban systems (Rouse, 2015), and, as discussed in the following text, universities

Complex adaptive systems have the following characteristics:

- They tend to be **nonlinear, dynamic** and do not inherently reach fixed equilibrium points. The resulting system behaviors may appear to be random or chaotic
- They are composed of **independent agents** whose behaviors can be described as based on physical, psychological, or social rules rather than being completely dictated by the physical dynamics of the system
- Agents' needs or desires, reflected in their rules, are not homogeneous and, therefore, their **goals and behaviors are likely to differ or even conflict**—these conflicts or competitions tend to lead agents to adapt to each other's behaviors
- Agents are **intelligent and learn** as they experiment and gain experience, perhaps via "meta" rules, and consequently change behaviors. Thus, overall system properties inherently change over time
- Adaptation and learning tend to result in **self-organization** and patterns of behavior that emerge rather than having been designed into the system. The nature of such emergent behaviors may range from valuable innovations to unfortunate accidents
- There is **no single point(s) of control**—system behaviors are often unpredictable and uncontrollable, and no one is "in charge." Consequently, the behaviors of complex adaptive systems usually can be influenced more than they can be controlled

As summarized in Table 1.1, understanding and influencing systems having these characteristics creates significant complications. In general, leaders, who have more

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