Paul M. Leonardi, **Car Crashes Without Cars: Lessons About Simulation Technology and Organizational Change From Automotive Design**, 2012, Cambridge, MA: MIT Press, 352 pp., $35.00 (hardcover).

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In **Car Crashes Without Cars: Lessons About Simulation Technology and Organizational Change From Automotive Design**, Paul M. Leonardi draws from the communication, sociology, engineering, and management disciplines to offer three distinct contributions. First, he advances a theory of imbrication. Second, he compares and contrasts his theory with past theorizing about the interaction of communication and technology. Third, Leonardi reports on the analysis of various data that he collected on more than 10 years of development, implementation, and use of simulation technology at a U.S. automobile manufacturer. Through his case, the author introduces the imbrication perspective to analyze material and social agency during the organizing process.
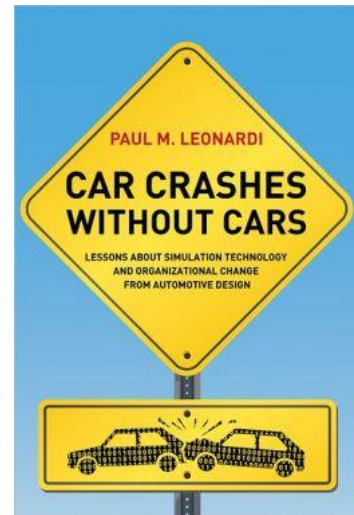
Leonardi begins immediately with the bold suggestion "that organizations and technologies are made up of the same basic building blocks: human and material agencies" (p. 5) and presents his imbrication perspective. Whereas people enact human agency or "the ability to form and realize goals [intentionally]" (p. 5), technologies enact material agency when they perform actions not directly or completely in control of their users. The author builds on work by James Taylor (2001), Saskia Sassen (2002), and Claudio Ciborra (2006) that characterizes interwoven material and social agencies as imbrication. Leonardi previews the process of imbrication by introducing the metaphor of interlocking curved and flat roof tiles—imbrices and tegulae, respectively, that are found in ancient Roman and Greek architecture—to describe the interaction of human and material agencies. He asserts that imbrication "allows us to move past a metaphor of coevolution and [consider] the act of developing and using technologies [as] a constitutive feature of the organizing process" (p. 7). He claims that imbrications, as a process, can provide "better explanations of why workplace change unfolds as it does, but . . . also explain why people come to think that those changes had to occur as they did" (p. 7). Imbrication is the central theoretical contribution that Leonardi makes and from which he draws on throughout the book.

In chapter 2, Leonardi frames the reader's understanding of various theoretical approaches in writings on technology and society. He rejects former perspectives because they have employed an "implementation line" or an empirical and theoretical divide between technology feature development and technology use that is based on the propositions of technological determinism. Leonardi positions imbrication as a new sociomaterial perspective that denies "any separation of technology from organizing" (p. 40). Imbrication "implies a gradual process of interrelation" that provides "no way of knowing what is cause and what is effect" (p. 44) where "social agency exists in patterns of communication and material

agency in a technology's material features" (p. 45). Leonardi invokes affordances and constraints as catalysts for imbrications because "[T]he perception of constraints produces a sequence of imbrication that changes technology features, whereas the perception of affordances produces a sequence of imbrication that changes communication patterns" (p. 52). He concludes the chapter with emphasis on the possibilities of the imbrication theory in studying change processes.

In chapter 3, Leonardi recounts his ethnographic study of the development, implementation, and use of an advanced math-based computer simulation technology called CrashLab at an automobile company's engineering center in Michigan. CrashLab was developed as a new computer-aided engineering tool for crashworthiness analysts to reduce costs for the company. The chapter reviews Leonardi's data collection and provides in-depth detail about the world of collision testing, international and national safety standards, and the structure of the organization.

In the next two chapters, Leonardi describes the organizational visions and processes in successfully developing CrashLab. Chapter 4 sees the author adopt a sociotechnical view that "problems aren't floating around 'out there' waiting to be identified; instead, members of invested organizations actively develop problems" (p. 87). He describes how four divisions had each constructed problems that could only be solved with a new tool for analysts. Leonardi describes each division's culture to contextualize their strategic directions and he discusses the work practices they focused on fixing that lead to technology innovation to solve those problems.

In chapter 5, Leonardi examined the integration of the divergent interests of the four divisions and the technologies they identified into the CrashLab prototype. He argues that organizational interdependencies are rich sites of innovation, but they often encounter barriers to common interpretation that impede technological production. The author explains, "Though Autoworks' organizational structure separated the four groups from one another in effect creating the mechanisms that would produce distinct technological frames, the process of developing a new technology, which required them to coordinate their efforts, brought them together" (p. 135). Leonardi extends Lévi-Strauss' (1966) concept of articulation as a process through which parts that have been artificially separated then rejoin to become whole to analyze co-orientation between the technological frames of the groups involved in math-based analysis. The author describes how the articulation between the visions created by Safety, Techpro, Infoserv, and R&D occurred through these processes and resulted in CrashLab.

In chapters 6 and 7, Leonardi explores the user-level implementation and use of the CrashLab technology. He relies on Weick's (1979) sensemaking, in chapter 6, to describe the discursive realities that are adopted by trainers who implemented CrashLab in two user groups. He states that "crashworthiness analysts' interpretations of CrashLab arose out of the confluence of users' interactions with one another and with artifacts during the course of their routine work" (p. 180). The Piston Group in the Car Department functioned on a "discourse of efficiency," which emphasized features of CrashLab that would help engineers perform faster and more consistently. Different implementers introduced the "discourse of inevitability" to the Strut Group in the Truck Department. By analyzing several quotations in both groups, Leonardi found that "the interpretations analysts developed of CrashLab through their interactions with people were reinforced by their interactions with artifacts" (p. 234). These competing discourses resulted

in vastly different appropriations between working groups. Through this analysis, Leonardi focuses attention on the process by which users draw faulty interpretations of causality.

In chapter 7, Leonardi explains that "features often become decoupled from the 'spirit' in which a technology was designed . . . [and] may evince multiple 'spirits' or agendas" (p. 238). The author refers to the adaptive structuration concept of spirit or to the way that technologies lead people to act on and use them (Poole & DeSanctis, 1990). Analysts in the Piston Group found that the discourse of efficiency was at odds with their work experiences in using CrashLab and began to interpret the tool as inefficient. The discourse of inevitability, by comparison, was generic enough to allow analysts in the Strut Group to consider various uses for CrashLab and eventually employ it as an efficient modeling tool if used with other preprocessors. Leonardi found that "CrashLab enabled a profound change in the organization of crashworthiness work in the Strut Group" (p. 261), which used the discourse of inevitability to "converge on a common use of the technology" (p. 261). He describes that through appropriation, or by using the technology for one's own purposes, analysts "actively aid in the social construction of a technology's features" (p. 240). The CrashLab practices in the Strut group contrasted starkly with those of the Piston group, but they did align with the automaker's primary objectives to reduce time setting up models and increase time devoted to analysis.

In the final chapter, Leonardi concludes with a summary of the imbrication perspective that restores agency to humans and artifacts in the process of organizing and technological change. The paramount implication of the imbrication framework, the author writes, is that "it seems more appropriate to make both ontological and empirical claims about the relationship between [social and material] agencies rather than about the relationship between organizations and technologies" (p. 278). Leonardi displays the path-dependent chain of imbrications—or the back and forth between social and material agencies—through constraints and affordances in a helpful summary chart (p. 268). He also identifies moments in the development of CrashLab to think of "the life cycle of a new technology as a chain of decision points" (p. 288). In sum, Leonardi presents imbrication as a process perspective that explains how social and material agencies, through affordances and constraints, shape technologies and organizations in the process of organizing.

Leonardi's book is an impressive, well-written artifact of rich ethnographic detail, with numerous quotations, diagrams, and explanations. The volume expands on the author's previously published journal articles and imparts a deep level of understanding regarding not only the world of Autoworks and its analysis technologies but also cross-disciplinary theories on technological and organizational change. However, sporadic mentions of data throughout the book and several reintroductions of groups suggest that a consolidated methodology section would be an improvement.

Leonardi's analysis generates three additional ideas regarding technological and organizational change. Through the imbrication perspective, he squarely addresses the debate among communication, sociology, technology, and Internet researchers, landing in opposition to social constructivists by stating that technology has material agency but is devoid of intention (Latour, 1987; Pinch & Bijker, 1984; Poole & DeSanctis, 1990). Leonardi thoroughly reviews the various perspectives in the debate, but the question remains: Is technology devoid of intentionality if people design it, as imbrication suggests, or is it merely

divorced from the intentions of the user? By focusing on the way that social and material agencies contribute to the organizing process, Leonardi chooses not to articulate the process in which social agency is transformed into material agency or how artifacts acquire their agency.

Second, the imbrication perspective shares roots with bricolage (Lévi-Strauss, 1966), or the layering of ideas or materials from a variety of places to create a new identity or artifact. The advantage of imbrication is to discern between material and social agencies in analysis, a helpful demarcation that scholars could use to understand complex interactions.

Third, although not explicitly discussed in the book, the discourse of inevitability, which allowed the Strut Group to successfully appropriate CrashLab, strongly maps onto the ideas of technological determinism. Deterministic perspectives, social or technological, are often unhelpful for researchers because they assume inevitable outcomes. However, the framing of CrashLab as an inevitable technology is ultimately helpful in its implementation and use at the company. Perhaps the persistence of technological inevitability in common parlance derives from its wide use in industry implementations, though Leonardi does not speculate on this idea or its potential value for managers.

Ultimately, Leonardi offers the imbrication perspective as a call for change in the study of technological and organizational change processes by focusing on the interaction of social and material agencies. Through an engaging case, he describes how both people and technologies have agencies that allow organizations to develop in reaction to affordances or constraints. The rich detail of an organization grappling with the development and use of a technological innovation should appeal to management and communication scholars alike. Although intended for an academic audience, practitioners will find chapters of interest about managing technological change in industry. The theoretical and practical relevance of sociotechnical perspectives makes Car Crashes Without Cars: *Lessons About Simulation Technology and Organizational Change From Automotive Design* an indispensible resource for scholars and managers interested in the cyclical nature of change in technology and organizations.

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