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Applying an Aerodynamics Inspired Organizational Dynamic Fit Model to Disaster Relief Endeavors

by

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ABSTRACT

Organizational design has long represented a challenging endeavor, but this challenge is exacerbated when attempting to design collectivities comprised of multiple organizations. Nonetheless, we can bring to bear the rich armamentarium of Contingency Theory to help guide our inter-organizational design endeavors. A fundamental problem, however, stems from the predominate research focus on static fit, a focus that is incommensurate with the fundamentally dynamic nature of organizations and their environments. Most key organizational environments are inherently dynamic, hence the corresponding organizational designs required for fit are necessarily dynamic too. This problem grows even more severe in the context of inter-organizational design, particularly where the participating organizations comprising a collectivity come and go over time. Addressing in part some longstanding calls in the literature for more dynamic conceptualization of fit, a novel approach utilizes the dynamical language and integrated system of concepts, definitions and interrelationships from the engineering field Aerodynamics. This approach is broadly applicable, and it can help to elucidate organizational design and engineering issues even in the very complex context of inter-organizational collectivities. In this article, we begin with a focused summary of such dynamic fit conceptualization, and we illustrate its use through empirical application to a very complex inter-organizational case involving thousands of participating organizations attempting to provide multinational disaster relief.

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I. INTRODUCTION

Organizational design has long represented a challenging endeavor, for attempting to establish and preserve good fit—which Donaldson (2001) defines as a match "… between the organization structure and contingency factors that has a positive effect on performance" (pp. 7-10)—is a complex undertaking (Burton, DeSanctis, & Obel, 2006). Unlike the design of engineered artifacts and physical systems (e.g., airplanes, bridges, computers), the components of which include generally highly predictable and very well-understood parts and subsystems, the design of organizations (e.g., business, government, non-profit) involves people, routines and like elements, which are comparatively much, much less-predictable and -understood (Nissen & Levitt, 2004). Using Ackoff's (1971) terms, design in the former sense pertains to *organisms*, in which purposeful action applies to the whole system only, whereas design in the latter sense pertains to *organizations*, in which such purposeful action can be identified in the constituent system parts as well; designing systems in which the constituent parts have wills of their own involves considerable uncertainty and unpredictability.

This challenge is exacerbated when attempting to design collectivities comprised of multiple organizations. Not only are the constituent parts (esp. people) of such organizations willful and unpredictable, but the organizations themselves are purposeful and unpredictable as well; hence the considerable uncertainty and unpredictability associated with design are magnified in the inter-organizational context.

Nonetheless, we can bring to bear the rich armamentarium of Contingency Theory (Burns & Stalker, 1961; Lawrence & Lorsch, 1967; Woodward, 1965) to help guide our inter-organizational design endeavors. Contingency Theory is very well-established in the organization and management sciences and has supported organizational design for more than half a century. Moreover, myriad empirical studies (e.g., Argote, 1982; Donaldson, 1987; Hamilton & Shergill, 1992; Keller, 1994; cf. Mohr, 1971; Pennings, 1975) support our understanding of how different organizational designs affect fit with a wide variety of multiple, often-conflicting contingencies (Gresov, Drazin, & Van de Ven, 1989; Gresov & Drazin, 1997; Meyer, Tsui, & Hinings, 1993; Whittington & Pettigrew, 2003). Further, we have for several decades been conceptualizing and analyzing multi-organizational designs, including Divisionalized Structures (Mintzberg, 1979), Network Organizations (Miles & Snow, 1978), Clans (Ouchi, 1980), Virtual Organizations (Davidow & Malone, 1992), Platform Organizations (Ciborra, 1996) and other organizational collectivities.

A fundamental problem, however, stems from the predominate research focus on static fit, a focus that is incommensurate with the fundamentally dynamic nature of organizations and their environments (Donaldson, 2001; Sinha & Van de Ven, 2005). Most key organizational environments are inherently dynamic (Yu, Tu, & Pattipati, 2008), hence the corresponding organizational designs required for fit are necessarily dynamic too (Nissen & Leweling, 2008). This problem grows even more severe in the context of inter-organizational design, particularly where the participating organizations comprising a collectivity come and go over time, through a multi-organizational instantiation of discontinuous membership (Ibrahim & Nissen, 2007).

Addressing in part some longstanding calls in the literature for more dynamic conceptualization of fit (Burton, Lauridsen, & Obel, 2002; Zajac, Kraatz, & Bresser, 2000), a novel approach (Nissen & Burton, 2011) utilizes the dynamical language and integrated system of concepts, definitions and interrelationships from the engineering field Aerodynamics. This approach is broadly applicable, and it can help to elucidate organizational design and engineering issues even in the very complex context of inter-organizational collectivities. In this article, we begin with a focused summary of such dynamic fit conceptualization, and we illustrate its use through empirical application to a very complex inter-organizational case involving thousands of participating organizations attempting to provide multinational disaster relief.

II. BACKGROUND

In this section we draw heavily from Nissen & Burton (2011) to outline a novel approach to dynamic conceptualization of fit, which utilizes the dynamical language and integrated system of concepts, definitions and interrelationships from the engineering field Aerodynamics. Aerodynamics (Houghton & Carruthers, 1982) concerns the motion of systems designed for flight (e.g., airplanes), most of which are highly dynamic, controlled systems; that is, the systems themselves reflect inherent dynamic capabilities (e.g., speed, stability, maneuverability) that are designed in, but they receive directional inputs (esp. from pilots) during flight (e.g., taking off, climbing, turning).

Airplane designers analyze the intended uses (e.g., family recreation, passenger transportation, military combat) and expected environments (e.g., clear weather, turbulent storms, hostile airspace) to tailor design characteristics and capabilities in ways that balance often-competing design goals such as system performance, reliability and cost. As such, airplanes are designed deliberately to fit their intended uses (e.g., commercial aircraft vs. military fighters) and expected environments (e.g., extreme weather vs. enemy fire), and different designs are required to fit different use-environmental contexts; large commercial passenger jets are unable to land on aircraft carriers, nor are naval fighter jets able to carry hundreds of passengers, for instance.

Human activity systems such as organizations are not engineered physical systems like airplanes, but both represent classes of *systems* (Checkland, 1981)—indeed, open systems (Johnson, Kast, & Rosenzweig, 1964; Kast & Rosenzweig, 1972), which are engineered, managed (Feigenbaum, 1968) and controlled (Beer, 1966)—and share attributes (e.g., recognizable inputs, outputs, boundaries and others) at some level of abstraction (Sauser, Boardman, & Verma, 2010; von Bertalanffy, 1969). Here the abstraction is much more about the *design* of airplanes and organizations than their *control*. Hence the airplane-organization analogy draws much more closely on *engineers* (i.e., who design airplanes) than on *pilots* (i.e., who fly them).

Pilots do their best to control the airplanes that engineers have designed, but (in the short-term) they have negligible control over the designs themselves. Likewise, managers do their best to control the organizations as designed, but (in the short-term) they have negligible control over the designs themselves. When we use the term *organizational management* in this discussion, we refer to managers in a role comparable to that of pilot: focused on maneuver and control. When we use the term *organizational design*, alternatively, we refer to a role more comparable to that of engineer: focused on design and analysis.

A. BASIC CONCEPTUAL MODEL

With this, the basic conceptual model is depicted in Figure 1. Through considerable simplification[1], the aerodynamics concepts and relationships between *static stability, dynamic stability, maneuverability* and *technology* are depicted in a manner that can apply to the domains of both airplanes and organizations. We diagram these central concepts and interrelationships as boxes and arrows in the figure and explain them below.

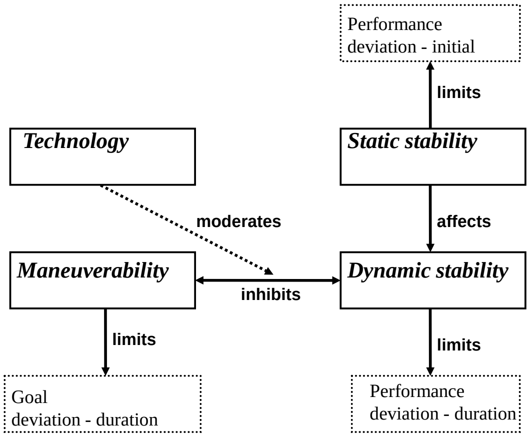

Figure 1 Basic Conceptual Model [adapted from (Nissen & Burton, 2011)]

Table 1 summarizes the four key concept definitions and provides examples from both the airplane and organization domains. First, static stability, which concerns a system's initial resistance to deviation from its dynamic trajectory from an external force, maps from airplane design to organization design by considering performance. A statically stable airplane resists deviation from its intended altitude, for instance, by wind gusts, and a statically stable organization resists deviation from its intended profit[2] level, for instance, by changed consumer preferences. Hence static stability limits initial performance deviation (e.g., maintaining desired airplane altitude, maintaining desired organization profitability).

Dynamic stability, which concerns the quickness of a system's return to its dynamic trajectory after deviation from an external force, maps from airplane design to organization design by considering performance also. A dynamically stable airplane returns quickly to its intended altitude, for instance, after deviation by wind gusts, and a dynamically stable organization returns quickly to its intended profit level, for instance, after deviation by changed consumer preferences. Hence dynamic stability limits the

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[1] Simplification is important, for our understanding of organizations as human systems does not support the kinds of precise, mathematical representations and corresponding analytical methods used to model, design and analyze airplanes and like physical systems. Such simplification also facilitates translation of research along these lines to the organization and management domain.

[2] As a note, we can substitute a multitude of alternate performance measures for airplanes (e.g., heading, speed, attitude, fuel efficiency, passenger comfort) or organizations (e.g., market share, cycle time, liquidity, operating margin, employee welfare) to emphasize model generality.

duration of performance deviation (e.g., maintaining desired airplane altitude, maintaining desired organization profitability).

Table 1 Concept Definitions and Examples [adapted from (Nissen & Burton, 2011)]

Concept	**Definition**	**Airplane**	**Organization**
Static stability	A system's initial resistance to deviation from its dynamic trajectory from an external force	Initial resistance to deviation in altitude from wind gust	Initial resistance to deviation in profit level from change in consumer preferences
Dynamic stability	Quickness of a system's return to its dynamic trajectory after deviation from an external force	Quickness of return to initial altitude following a deviation from wind gust	Quickness of return to initial profit level following a deviation from change in consumer preferences
Maneuverability	Quickness of a controlled system's planned change from one trajectory to another	Quickness of planned change in direction	Quickness of planned change in product lines
Technology	Enhances control of a dynamic system	Computer flight control system enables human control despite quick direction change	Management information system enables human control despite quick product line change

Maneuverability, which concerns the quickness of a controlled system's planned change from one trajectory to another, is inhibited by stability and vice versa: the more stable an airplane, for instance, the less maneuverable it is, and the more stable an organization, for instance, the less maneuverable also. A maneuverable airplane can change direction or altitude, for instance in response to the pilot's goal change, quickly, and a maneuverable organization can change product line or profit level, for instance, in response to the manager's goal change quickly as well. Hence maneuverability limits the duration of goal deviation (e.g., achieving a new airplane heading or altitude, achieving a new organization product line or profitability).

Finally, technology can enhance control of a dynamic system. Computer flight control systems, for instance, enable pilots to control highly unstable yet maneuverable airplanes (e.g., to maintain desired heading and altitude), and management information systems, for instance, enable managers to control highly unstable yet maneuverable organizations (e.g., to maintain desired product line and profitability). Hence technology moderates the interrelation between maneuverability and dynamic stability.

Technology can play other roles as well, both in terms of the control and design of airplanes and organizations. Consider airplane simulators, for instance, which pilots use extensively to practice both routine and dangerous maneuvers in the safety of ground-based, computer systems with no risk to life or aircraft. Likewise, managers can practice both routine and risky decision making, for instance, through organization simulation systems (Gopinath & Sawyer, 1999; Sterman, 2000) with no risk to careers or profits. As another instance, consider computer-aided design and engineering systems (CAD/CAE) that enable engineers to evaluate the system properties and behaviors of myriad alternate airplane designs through corresponding virtual prototypes. Likewise, virtual organization design systems (Gateau, Leweling, Looney, & Nissen, 2007; Levitt, Thomsen, Christiansen, & Kunz, 1999) enable organizational designers to evaluate the system properties and behaviors of myriad alternate organization designs through corresponding virtual prototypes.

B. ILLUSTRATIVE AIRPLANE AND ORGANIZATION TRAJECTORIES

The illustrative airplane and organization trajectories delineated and described in this section provide concrete examples derived from the basic conceptual model above. Such examples are kept purposefully very simple (e.g., linear motion, discrete time, single variable) to illustrate the key points of comparison and insights from our airplane-organization analogy. Given the considerable sophistication and empirical power of Aerospace Engineering, more complex applications are straightforward to conceive; we leave such conceptualization to future research.

1. Static stability

With continued simplification of aerodynamic theory as above, we annotate Figure 2 to delineate a very simple, linear trajectory of an airplane (i.e., “Airplane A”) in terms of the single variable *altitude* (in kilometers) over time. We use this and like figures below for analytical description and conceptual illustration. The eight circular plot points in the figure delineate the airplane’s altitude at discrete times during flight. Beginning with level flight at the goal altitude of 4 km, the figure depicts a disruption (e.g., wind shift) that changes the airplane’s altitude from the goal to the 3 km level. This altitude change from goal can be viewed as a 1 km performance deviation. *Static stability* characterizes how resistant airplane performance is to environmental disruptions; despite the word “static,” this term describes a dynamic property of airplanes (i.e., resistance to disruption). Notice that such dynamic property is designed into the system by engineers and has little to do with the pilots who fly them.

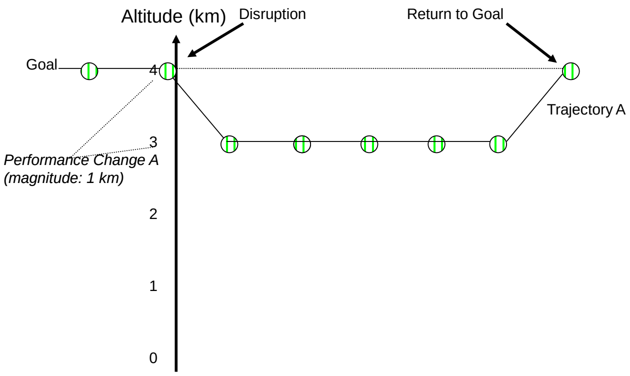

Figure 2 Airplane A Trajectory [adapted from (Nissen & Burton, 2011)]

In this example the magnitude of altitude change (i.e., 1 km performance deviation) provides a basis for comparison with the static stability of other airplane designs. An airplane that experiences less altitude change from a particular disruption can be said to reflect greater static stability than an airplane which moves more (and vice versa). Indeed, an *ideal system* (e.g., perfectly stable airplane) would experience no altitude change from the disruption and hence not spend any time away from the goal. The horizontal dotted line in Figure 2 depicts how the trajectory of a perfectly stable airplane would remain at the 4 km altitude level and experience no performance deviation. The 1 km altitude change experienced by Airplane A reflects lesser static stability than that of an Ideal System.

In terms of organizations, we annotate Figure 3 to delineate a very simple, linear trajectory of an organization (i.e., "Organization A") in terms of the single variable *profit* (in $billions) over time. The eight circular plot points in the figure delineate the organization's profit at discrete times during operations. Beginning with steady profit at the goal level of $4B, the figure depicts a disruption (e.g., changed consumer preferences) that changes the organization's profit from the goal to the $3B level. This profit change from goal can be viewed as a $1B performance deviation. *Static stability* characterizes how resistant organization performance is to environmental disruptions.

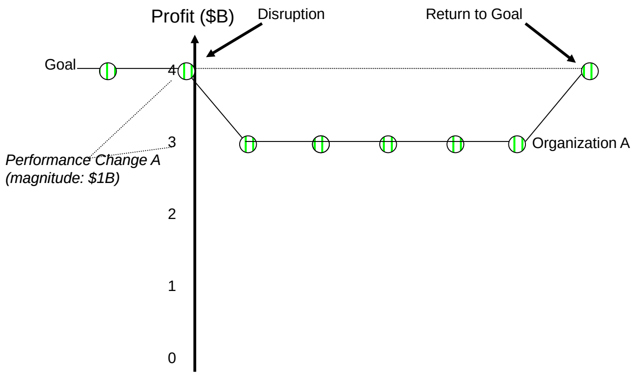

Figure 3 Organization A Trajectory [adapted from (Nissen & Burton, 2011)]

A key insight from our airplane-organization analogy emerges: the performance deviation associated with airplane static stability is analogous to the manner in which many scholars characterize the converse of organizational fit (Donaldson, 2001): "misfit produces a negative effect on organizational performance" (p. 14). Misfit is a deviation from the ideal or goal state and provides a basis for comparing the relative misfit of other organizations. An organization with greater performance deviation (e.g., from environmental disruption) is in greater misfit than one with lesser deviation. Hence *static stability* and *misfit* represent relatively good analogs: the greater the static stability of an organization, the lesser the performance deviation it experiences from environmental disruption.

2. Dynamic stability

Notice that airplane static stability as reflected in Figure 2 does not take into account the time in flight spent at an altitude below the 4 km goal. Even as a dynamic concept, it is insensitive to how quickly the airplane returns to its goal altitude: it addresses the magnitude of performance deviation but does not address time. The same applies to organization static stability reflected in Figure 3: it is insensitive to how quickly the organization returns to its goal profit level, and it addresses the magnitude of performance deviation but does not address *time*.

In contrast, as depicted in Figure 4, *dynamic stability* represents both the magnitude and duration of performance deviation (i.e., 1 km x 5 t = 5 kmt altitude change for Airplane A) and characterizes both how much and how long system performance is affected by the disruption: it measures explicitly how quickly the system returns to its goal altitude as well as the extent of altitude change. As above, the combined magnitude and duration of performance deviation provides a basis for comparison with the dynamic stability of other airplane designs. For a given altitude change from a particular disruption, an airplane that spends less time away from the goal can be said to reflect greater dynamic stability. When viewed in comparison with an ideal system (e.g., the horizontal line at goal altitude in Figure 4), dynamic stability can be measured as the area between the ideal and focal system trajectories; the greater the area, the lesser the dynamic stability and vice versa.

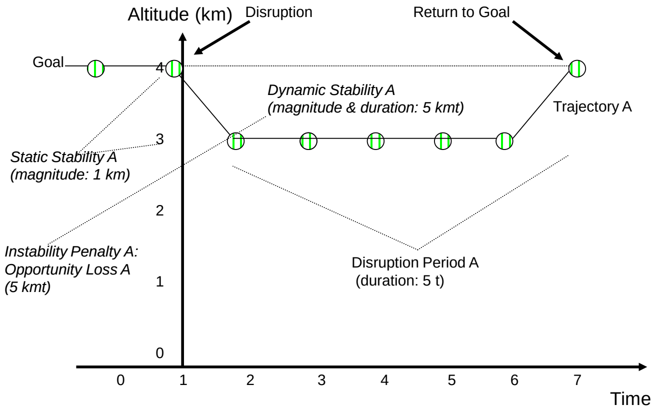

Figure 4 Airplane A Dynamic Stability [adapted from (Nissen & Burton, 2011)]

Further, Airplane A pays something of an instability penalty: since it exhibits lesser dynamic stability than the Ideal System does, it spends more time away from the goal altitude and incurs an opportunity loss during this period away from goal (e.g., consider burning fuel at a faster rate while at lower altitude). When viewed in comparison with the Ideal System Trajectory in Figure 4, opportunity loss can be measured as the area between the ideal and focal system trajectories also; the greater the area, the greater the opportunity loss and vice versa. Hence, as shown in the figure, we can relate dynamic stability to opportunity loss.

In terms of organizations, the dynamic stability concept incorporates *time* explicitly into our conceptualization. Most directly, we can characterize dynamic stability in terms of the combined magnitude and duration of an organization's performance deviation from the goal. When viewed in comparison with an ideal organization, dynamic stability can be measured as the area between the ideal and focal organization trajectories; the greater the area, the lesser the dynamic stability.

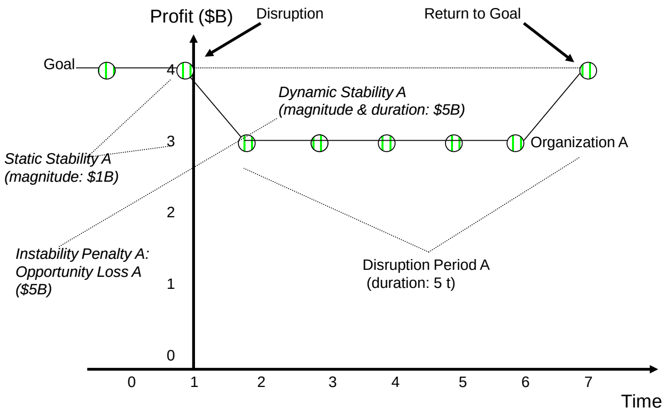

Figure 5 Organization A Dynamic Stability [adapted from (Nissen & Burton, 2011)]

Figure 5 illustrates this conceptualization with a comparison of trajectories between an ideal organization (i.e., represented by the horizontal dotted line with no performance deviation from the $4B goal profit level) and that of Organization A. This graphic is identical to Figure 3 above, except we label the static and dynamic stability explicitly for Organization A. Specifically, we show static stability as the magnitude of performance deviation ($1B) associated with the environmental disruption at Time 1 and dynamic stability as the area between the ideal and focal organizations' performance trajectories (i.e., combined magnitude and duration of deviation; $1B x 5 = $5B). As in the static case above, the horizontal dotted line in Figure 5 depicts how the trajectory of an organization with perfect dynamic stability would remain at a goal level (e.g., in terms of a $4B profit level) and experience no performance deviation for all seven time periods. The lesser dynamic stability (i.e., greater dynamic instability) exhibited by Organization A reflects a $5B instability penalty, which can be interpreted as an opportunity loss.

3. Maneuverability

As above, we annotate Figure 6 to delineate the dynamic trajectory of Airplane A in terms of altitude over time but here to illustrate the concept *maneuverability*. A goal change (e.g., to avoid colliding with another airplane) at Time 1 shifts the airplane's desired altitude from 1 km to the 4 km level, and every altitude below the new 4 km goal can be viewed as a performance deviation that persists until the new goal is reached (e.g., six time periods for Airplane A).

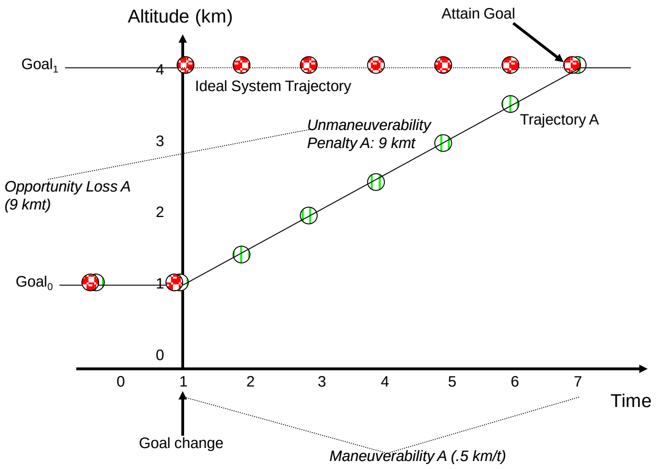

Figure 6 Airplane A Maneuverability [adapted from (Nissen & Burton, 2011)]

Maneuverability in this example represents the magnitude of altitude change that an airplane can make per unit time: the more maneuverable that an airplane is, the greater change in altitude it can make in a given amount of time, or the less time it requires for a given change in altitude. As depicted in the figure, the maneuverability of Airplane A (i.e., .5 km/t) reflects its ability to increase altitude by half a kilometer in each time period. Unlike our stability examples above, where the airplane trajectory is disrupted externally, here we are examining what can be done purposefully to an airplane (e.g., change altitude).

Indeed, an *ideal system* (e.g., perfectly maneuverable airplane) would make the change in altitude immediately and hence not spend any time away from the new goal. This is depicted by the Ideal System Trajectory delineated in the figure; the Ideal System stays at the 1 km goal altitude through Time 1, after which it increases to the 4 km level immediately after the goal change. As above, the combined magnitude and duration of performance deviation provides a basis for comparison with the maneuverability of other airplane designs. For a given altitude change from one goal to another, an airplane that spends less time away from the new goal can be said to reflect greater maneuverability. Likewise, for a given period of time away from the new goal, an airplane that effects greater altitude change can be said to reflect greater maneuverability.

Further, Airplane A pays something of an unmaneuverability penalty: since it exhibits lesser maneuverability than the Ideal System does, it spends more time away from the goal altitude, and as above it incurs an opportunity loss during this period away from goal. When viewed in comparison with the Ideal System Trajectory in Figure 6, opportunity loss can be measured as the area between the ideal and focal system trajectories; the greater the area, the lesser the maneuverability, greater the opportunity loss, and vice versa. Hence, as shown in the figure, we can relate maneuverability to opportunity loss.

In terms of organizations, consider the maneuverability of Organization A with its trajectory depicted in Figure 7 along with that of the corresponding ideal organization. In this comparison, Organization A requires six time periods to respond to a goal change (e.g., strategy shift) at Time 1. In comparison with the ideal organization trajectory—which reflects perfect maneuverability—we show a $9B area between the ideal and focal organizations' performance trajectories. The lesser maneuverability exhibited by Organization A reflects a $9B unmaneuverability penalty, which can be interpreted as an opportunity loss.

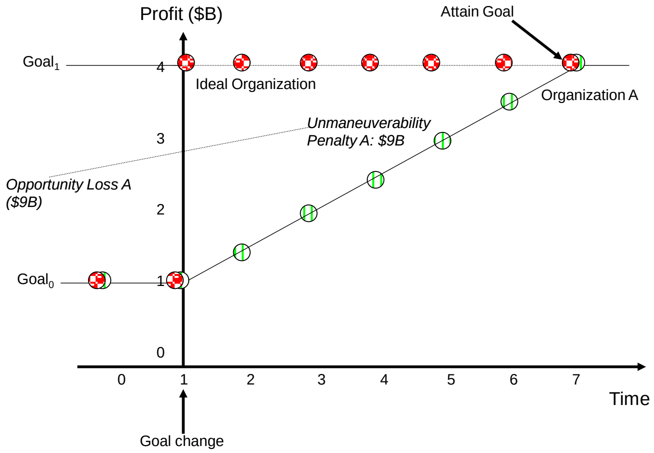

Figure 7 Organization A Maneuverability [adapted from (Nissen & Burton, 2011)]

4. Stability-Maneuverability Tradeoffs

An important tradeoff in aircraft design exists between stability and maneuverability. The tradeoff obtains because design aspects that contribute to aircraft stability (e.g., size, front loading of mass, rear concentration of pressure) degrade maneuverability and vice versa. In terms of organizations, an analogous design tradeoff would imply that highly stable organizations would not be particularly maneuverable and vice versa. The implication is that, when designing an organization to produce consistent results through environmental disruptions (i.e., emphasizing stability), for instance, management would have to sacrifice some capability for rapid organizational change (i.e., de-emphasizing maneuverability). Likewise, when designing an organization to enable rapid change (i.e., emphasizing maneuverability), as a counter instance, management would have to sacrifice some capability for robust performance (i.e., de-emphasizing stability).

5. Technology

Leveraging the fundamental tradeoff noted above, in today's Aerodynamics we note the counterintuitive trend in which modern aircraft are designed intentionally to be inherently unstable: unstable design enhances maneuverability. The problem is, of course, that such unstable yet maneuverable aircraft are exceptionally difficult to control—indeed beyond the ability of human pilots. It is only through the active assistance of technology such as computer flight control systems, and with a human pilot, that such aircraft can be flown at all.

In terms of organizations, substantial research addresses the role of information technology in balancing organizational flexibility with control (Brown & Eisenhardt, 1997; Eisenhardt & Martin, 2000; Kauffman, 1995) through real-time information, forecasting, marketing, product design and supply chain management (Sabherwal, Hirschheim, & Goles, 2001). Organizational instability through deliberate design, combined with analogous “flight control” management processes and information technology (Arciszewski, de Greef, & van Delft, 2009; Fan et al., 2010), may lead to greater maneuverability and may be essential for highly maneuverable organizations to be controlled at all.

C. EXTENDED CONCEPTUAL MODEL

At this point in the discussion, we have sufficient conceptual grist and organizational analogs to extend the conceptual model of dynamic organizational fit. In particular, summarizing from the discussion above, we identify the magnitude of performance deviation as key to empirical measurement of static stability, the combination of magnitude and time for dynamic stability, and the rate of change for maneuverability. Although it does not generate a straightforward approach to measurement, we also indentify information technology as central to the technology concept, and we include both instability and unmaneuverability penalties—and their corresponding opportunity losses—in Figure 8 as well.

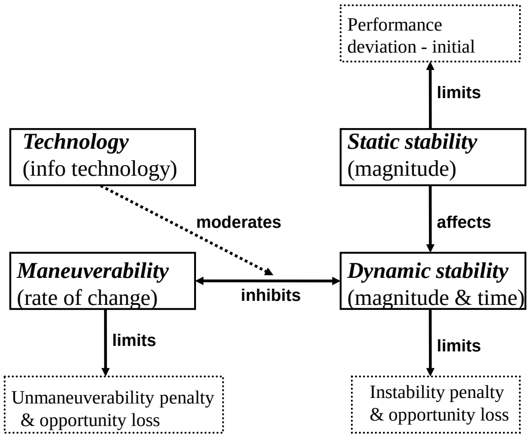

Figure 8 Extended Conceptual Model [adapted from (Nissen & Burton, 2011)]

This extended conceptual model is clearly very similar to its basic counterpart depicted in Figure 1, but it reflects several important extensions. For instance, in the extended conceptual model, we include operationalized constructs that suggest an approach to empirical measurement of key concepts (e.g., measure *static stability* through magnitude of performance deviation). We further identify penalties (e.g., instability penalty) and corresponding opportunity losses in terms of dynamic stability and maneuverability, and we include an explicit focus on *information* technology to enhance management control over organizations. This extended conceptual model of dynamic organizational fit, particularly with its operationalized constructs, outlines a theory-based framework that appears suitable for empirical testing.

III. EMPIRICAL DISASTER RELIEF CASE

In this section we summarize briefly the pertinent aspects of a very complex inter-organizational case involving thousands of participating organizations attempting to provide multinational disaster relief following the 2004 earthquake and resulting tsunami in the Indian Ocean. Here our intent is not to detail results from an in-depth case study; rather, we draw from secondary data sources (Comfort, 2006; SAS-065, 2008; SAS-065, 2010; Schulze, 2006; Sharpe & Wall, 2007; Telford & Cosgrave, 2006) to establish sufficient context and grist to illustrate the dynamic fit model described above. The interested reader is directed to the list of references for additional details.

Beginning with the key dates, on 26 December 2004 an extremely powerful (e.g., magnitude greater than 9.0 on the Richter Scale) undersea earthquake struck in the Indian Ocean just west of Indonesia. The nearby Aceh Province was devastated by a strong tsunami that was generated by this earthquake. 200,000 of Aceh's people were killed, including 50 percent of the civil service officials. More than a half million people were left homeless, and nearly a quarter of the infrastructure was destroyed, including most of the government offices located in coastal areas. Initially, the affected people did whatever they could to survive. After the tsunami receded, people's attention turned to rescue and relief. This effort reflected negligible, formal organization: people in local communities worked in an ad-hoc manner to help others in their communities.

On the following day, the Indonesian Vice President and advisory staff surveyed and assessed the tsunami devastation, and shortly afterward, the Indonesian Military massed to lead search and rescue, as well as mass burial, activities in the region. The Military also initiated an effort to help coordinate aid. The Military, with its stereotypical, unified chain of command and hierarchical organizational control structure, operated effectively within the scope of tasks that it set for itself, and during this initial period of reaction to and relief from the tsunami devastation, the two "organizations" (i.e., the Indonesian Military and the ad-hoc collections of people in local communities) operated independently of one another for the most part.

The International Community responded then with an outpouring of assistance. For several instances: the United Nations Disaster Assessment and Coordination Team arrived before New Years Day; nearly five thousand military troops from 11 foreign countries (e.g., Australia, Singapore, the United States) came to assist the Indonesian Military with its relief efforts; and by 31 January 2005, more than 3500 non-government organizations had arrived to provide humanitarian assistance and disaster relief. Several parts of the Indonesian Government beyond its military (e.g., its Central Planning Agency BAPPENAS, the Aceh and Nias Rehabilitation and Reconstruction Board BRR) got involved in the effort as well. Combined, this represents a huge number of relatively unaffiliated organizations attempting to work together in a hastily formed, inter-organizational collectivity.

Moreover, although all of these organizations were operating on scene at the request of and to assist the Indonesian Government, the Government was not in charge in the sense of directing their activities; rather, most of the various organizations accomplished the tasks that they knew best and perceived as most appropriate. Also, although the Indonesian Military coordinated with the militaries of several other nations, the resulting multinational military coalition did not coordinate actively or effectively with the myriad non-military organizations that were participating in the area.

Further, although the participants of this inter-organizational collectivity shared several common goals at a relatively high level, the collectivity as a whole was far from goal-congruent. Indeed, reports abound of considerable conflict, mistrust and friction between many of the different participating organizations, particularly those representing different interests (e.g., Indonesian Military and foreign militaries, militaries and non-government organizations, Indonesian and international non-government organizations). Indeed, the affected region marked the location of considerable anti-government rebel activity; yet even the Indonesian Military and opposing Rebel Forces shared the goal of overcoming the tsunami effects.

For certain, this inter-organizational collectivity was not designed explicitly; rather, it emerged and grew in a largely ad-hoc manner, albeit on a grand scale. Nonetheless, such collectivity reflected at least partially shared goals, and through a rational organizational lens, it can be considered to represent an "organization" (Scott, 2003). As such, fitness would apply, and although somewhat messy, the collectivity can be described in terms of its (organizational) structure and (design) configuration. Hence it provides a challenging yet feasible focus of our dynamic fit conceptualization.

Following this tsunami relief phase of activity (e.g., roughly from December through May), the most pressing needs in terms of emergency response had either been met or become moot, and the composition and character of the inter-organizational collectivity shifted toward longer term efforts associated with recovery and reconstruction. Many of the several thousand organizational participants in the collectivity dropped out, and the ad-hoc nature of the inter-organizational collectivity began to give way to more centralized organization led by the Indonesian Government.

We focus principally on the initial phase, concentrating in particular on the tsunami relief that followed immediate response in terms of search and rescue, for it reflects in particular the implications of dynamic organization and fitness. Further, our secondary data (SAS-065, 2008; SAS-065, 2010) provide a basis for instantiating the dynamic fit conceptualization characterized above. For instance, we have a timeline of roughly six months (i.e., December through May) that can be used to instantiate the dimension *time*, and these secondary data also provide the performance measure *maturity level*, which characterizes roughly (e.g., on a 5-level Likert scale) the relative degree of sophistication and efficacy in terms of inter-organizational collaboration and management. Moreover, we gain insight into the *required degree* (i.e., Level 4) of sophistication and efficacy (SAS-065, 2010, pp. 76-78). This maps relatively well to our conceptualization of what would be expected of an ideal organization.

In particular, a total of three, different, modal maturity levels are reported (SAS-065, 2010, pp. 99-101) during this time period: 1) the Indonesian Military and foreign military organizations operated at the relatively high Level 4; but 2) interaction of the militaries with non-government organizations (and between the myriad non-government organizations themselves) was evaluated at the very low Level 1; and 3) a "characteristic" Level 3 mode was assigned to the time periods and activities preceding and following our tsunami relief efforts of interest. When viewed in terms of inter-organizational design and fit, we consider the entire set of participating organizations, including the Indonesian and foreign governments and militaries as well as humanitarian, local and other non-government organizations, and we draw upon the corresponding ratings to instantiate the dynamic fit model below; that is, we examine and consider the entire inter-organizational collectivity.

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IV. MODEL APPLICATION

In this section we instantiate the dynamic fit model by drawing from the tsunami relief discussion above in order to illustrate the model empirically. We do so through two application steps: 1) first we discuss inter-organizational design and fit in terms of dynamic stability; 2) we then follow with discussion in terms of maneuverability.

A. DYNAMIC STABILITY ILLUSTRATION

Figure 9 illustrates our initial application of the dynamic fit model to the tsunami relief effort in terms of Step 1. This illustration is very similar to the dynamic stability figures presented above for airplanes (see Figure 4) and organizations (see Figure 5). On the horizontal axis, we display the applicable months in 2004 and 2005 (i.e., December through May) pertaining to the tsunami relief effort, and on the vertical axis, we include the maturity level ratings (1 – 5 scale) assigned in the case.

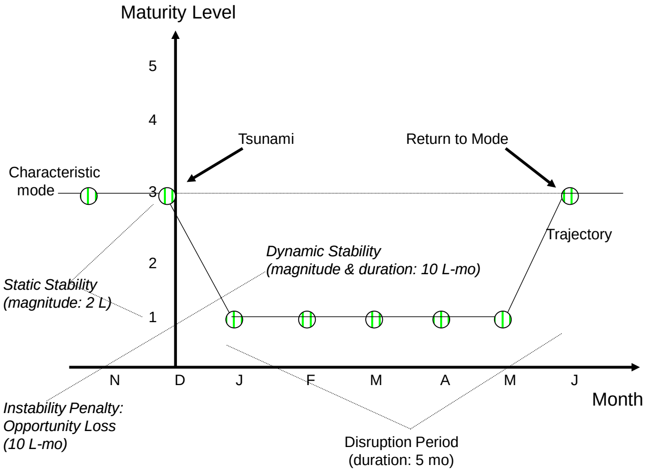

Figure 9 Dynamic Stability: Tsunami Relief Application

The trajectory, as delineated by circles plotted for each monthly time period, pertains to performance of the inter-organizational collectivity as a whole (i.e., Indonesian and foreign governments and militaries as well as humanitarian, local and other non-government organizations) from November 2004 through June 2005. It begins at the characteristic mode Level 3 and reflects the two-level degradation to Level 1 corresponding to the tsunami relief effort. As noted above and illustrated in the figure, this level persists through about May, after which the effort transitions toward the next phase, and the maturity level returns to its characteristic modal level. Notice, in some contrast with the airplane and organization trajectories described above, this characteristic modal level does not represent the "goal," per se; rather it represents the relative degree of sophistication and efficacy in terms of inter-organizational collaboration and management that existed immediately prior to and following the tsunami relief effort. We discuss dynamic performance in terms of required performance level (i.e., as a goal proxy) and maneuverability subsequently.

Here in Figure 9, static stability can be measured through the two-level decrease to Level 1 (i.e., static stability = 2L: 2 levels), and dynamic stability can be measured through additional consideration of the five month disruption period with performance at this level (i.e., dynamic stability = 2L x 5 mo = 10L-mo: 10 level-months). This reflects the inherent instability associated with the (implicit) inter-organizational design, which we quantify here as the area beneath the characteristic mode line to calculate the instability penalty and corresponding opportunity loss of 10 level-months.

Unlike an airplane burning fuel at a faster rate when flying at low altitude or an organization losing billions of dollars when neglecting shifts in consumer preferences, it is more difficult to provide concrete implications of instability penalty and opportunity loss in terms of tsunami relief. Nonetheless, when thousands of people's lives are at stake and millions of people are displaced, such penalty and loss have very real implications in terms of human death and suffering. If 10 level-months of instability penalty corresponds to, say, 100,000 deaths and a quarter million people displaced (i.e., roughly half the number of deaths and displacements reported in the case), then every 1 level-month translates to an associated opportunity loss in terms of a 10,000 lives that could have been saved and 25,000 people that could have avoided displacement. This operationalization adds considerable perspective to the importance of inter-organizational design and fit in the disaster relief context.

In order to illustrate this application case more fully, we draw from Contingency Theory and speculate a bit on an alternate, inter-organizational design that may have contributed to greater dynamic stability. Notice that we use the term *design* here even though the inter-organizational collectivity observed was never "designed" per se; rather the implicit design emerged through organizational action and interaction. Notice also that we draw from (organization) Contingency Theory to address an inter-organizational design problem; although imperfect, as noted above, such theory has expanded over the years to apply increasingly to multi-organizational designs in the inter-organizational context (Nissen & Burton, 2011).

In terms of an inter-organizational design alternative, the environmental context of conflict and mistrust between organizational participants stands out as a particularly dominant contingency in terms of results observed and reported through the tsunami case. The inter-organizational collectivity that emerged to provide disaster relief appears to have provided poor fit with respect to this aspect of its environment. Hence an inter-organizational redesign to address such poor environmental fit would represent a theory-consistent approach to take. Say, for instance, that the Indonesian and foreign militaries were able to embrace the non-government organizations as important partners and work to at least mitigate areas of major conflict between them. As such the inter-organizational collectivity may have managed to at least resolve one of the crippling conflicts experienced (i.e., between military and non-government organizations), which could have reduced the instability penalty and corresponding opportunity loss.

As such, consider some kind of inter-organizational *Adhocracy* or *Divisionalized Structure* design (Mintzberg, 1979) that includes military and non-government organizations alike. Either design would require an inter-organizational leader to both assume an influential role and be accepted in such role by the other organizational participants. Indeed, the Indonesian Government assumed a role along these lines in May 2005, and the level of conflict decreased, but this took place after five months of inter-organizational conflict and struggle and after many of the participating organizations had left the collectivity. In the Adhocracy design, the various organizations would coordinate only loosely and work according to their own, self-selected, core competencies within the Operating Core of an inter-organizational collectivity. In the Divisionalized Structure, such organizations would coordinate more formally with a central authority and work according to its, negotiated or assigned, priorities as separate divisions of an inter-organizational collectivity. Given the emergent and emergency nature of tsunami relief efforts, the former would appear to be more likely and responsive than the latter, unless considerable preplanning and inter-organizational preparation were to take place well before a disaster strikes.

In terms of the case and dynamic fit model, by simply deconflicting their activities, the inter-organizational collectivity could potentially raise its performance from Level 1to Level 2 (SAS-065, 2010). This new trajectory is delineated by a thick dashed line in Figure 10. Notice that even a one-level increase in maturity level such as this would cut the associated instability penalty and opportunity loss in half (i.e., to 5 level-months from the 10 level-months observed). Considering the implications in terms of human death and suffering, this represents 50,000 lives that may have been saved and 125,000 people that may have avoided displacement. We imply in no way that inter-organizational design and collaboration is easy—indeed, we study it because it is difficult—but rather we seek to illustrate how the associated poor dynamic fit can be measured, compared across different inter-organizational designs, and related to meaningful performance implications. Such implications focus on human death and suffering in the present case and illustration.

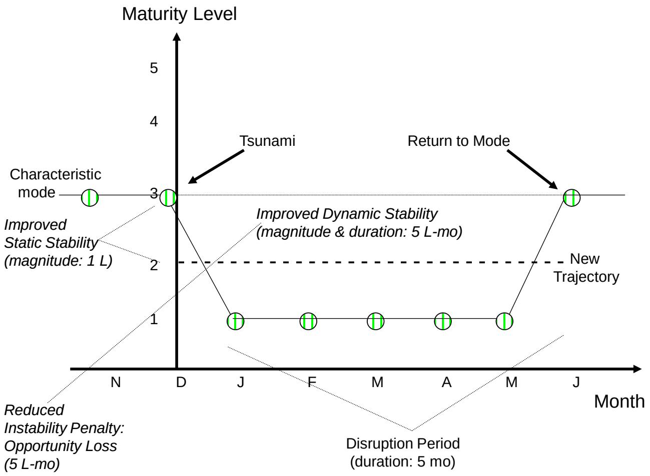

Figure 10 Improved Dynamic Stability: Tsunami Relief Application

B. MANEUVERABILITY ILLUSTRATION

Figure 11 illustrates our subsequent application of the dynamic fit model to the tsunami relief effort in terms of Step 2. This illustration is very similar to the maneuverability figures presented above for airplanes (see Figure 6) and organizations (see Figure 7), yet it also reflects many aspects of our tsunami relief case application above. Indeed, the entire trajectory and dynamic stability illustration from Figure 9 is repeated here, including the calculated instability penalty of 10 level-months represented by the area beneath the characteristic modal level (i.e., maturity level 3). Notice that we return here to the trajectory as observed in the case and as delineated via Figure 9, not the redesigned inter-organizational collectivity represented in Figure 10. Incorporation of redesign alternatives into the discussion and figures is straightforward, but we wish to stay with the case for this illustration and application of maneuverability.

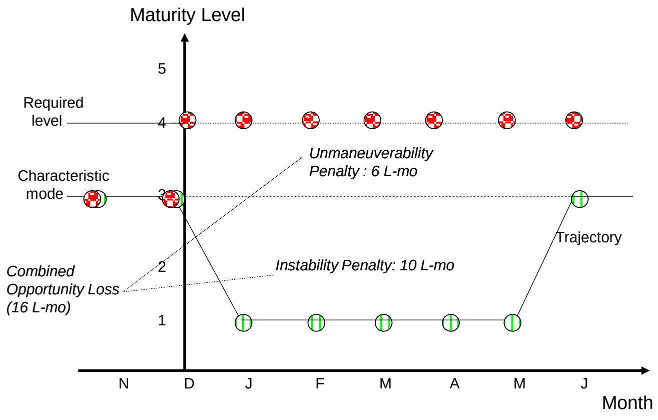

Figure 11 Maneuverability: Tsunami Relief Application

In addition, we draw further from the case to delineate the *required level* (i.e., maturity level 4) of sophistication and efficacy in terms of inter-organizational collaboration and management. The trajectory corresponding to this required level is clearly above both the characteristic modal level and observed trajectory. Although this, required level does not represent a goal, per se, we can use it as a goal proxy for purposes of instantiating the dynamic fit model. As such, the figure highlights additional opportunity loss—due to unmaneuverability penalty in this case—stemming from the inter-organizational collectivity being unable to maneuver to achieve the required performance level.

This translates to an additional six level-months of opportunity loss. Here we combine the ten level-months of opportunity loss discussed and delineated above (i.e., the area beneath the characteristic modal level) stemming from instability penalty with an additional six level-months of loss (i.e., the area between the required level and characteristic modal level) stemming from the unmaneuverability penalty for a total of 16 level-months (10 L-mo + 6 L-mo = 16 L-mo). As with the example above, this unmaneuverability penalty translates to an additional 60,000 lives that could have been saved and 150,000 people that could have avoided displacement.

In order to illustrate this application case more fully, we draw from more recent yet still developing organization theory, and we speculate still further on how other inter-organizational designs may have contributed to greater maneuverability. We understand, for instance, how ambidextrous organizations (Tushman & O'Reilly, 1999) are able to operate simultaneously in multiple modes. Through such multimodal operation, an inter-organizational collectivity may be able to preserve dynamic stability—and hence limit both the magnitude and duration of disruption from the tsunami—while enhancing maneuverability—and hence enabling performance at maturity level 4—at the same time. Our conceptual model of dynamic fit as presented above, however, indicates a fundamental tradeoff between stability and maneuverability, so it is unclear how such simultaneous enhancement of *both* stability and maneuverability could be effected.

Similar arguments pertain to resilience capacity (Lengnick-Hall & Beck, 2005), which emphasizes responsiveness, flexibility and an expanded action repertoire, along with the capability to select and enact the corresponding routines, and organizational semistructures (Brown & Eisenhardt, 1997), which focus on balancing order and flexibility. Through these latter approaches, it remains equally unclear how to enhance either stability or maneuverability (e.g., order or flexibility, respectively) performance without having to sacrifice performance of the other. Likewise with Edge organizations (Alberts & Hayes, 2003), which integrate aspects of Adhocracy, Professional Bureaucracy and Simple Structure (Gateau et al., 2007) to enable knowledge and power to flow from the tops and centers of (inter-)organizations to the bottoms and edges, and the dynamic capabilities approach (Teece, Pisano, & Shuen, 1997), which prescribes capabilities such as timely responsiveness, rapid and flexible product innovation, along with management capability to coordinate and redeploy resources as key. It remains unclear how to achieve such goals given mutually inhibiting interactions between stability and maneuverability.

Indeed, if the stability-maneuverability tradeoff is fundamental as outlined in our dynamic fit model, then the inter-organizational designer must sacrifice performance in one area for improvement in the other. Alternatively, if information or like technology exists that enables highly unstable—and highly maneuverable—inter-organizational collectivities to be controlled, or at least not fly out of control, then such technology would offer potential to moderate the mutually inhibiting interactions between stability and maneuverability. At the time of this writing, it remains unclear what kinds of technologies offer potential along these lines, and hence this represents a compelling topic for future research that can build upon the results of this investigation.

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V. CONCLUSION

Organizational design has long represented a challenging endeavor, but this challenge is exacerbated when attempting to design collectivities comprised of multiple organizations. Nonetheless, we can bring to bear the rich armamentarium of Contingency Theory to help guide our inter-organizational design endeavors. A fundamental problem, however, stems from the predominate research focus on static fit, a focus that is incommensurate with the fundamentally dynamic nature of organizations and their environments. Most key organizational environments are inherently dynamic, hence the corresponding organizational designs required for fit are necessarily dynamic too. This problem grows even more severe in the context of inter-organizational design, particularly where the participating organizations comprising a collectivity come and go over time.

Addressing in part some longstanding calls in the literature for more dynamic conceptualization of fit, a novel approach utilizes the dynamical language and integrated system of concepts, definitions and interrelationships from the engineering field Aerodynamics. Our basic conceptual model, for instance, depicts aerodynamics concepts and relationships between *static stability, dynamic stability, maneuverability* and *technology* in a manner that applies to the domains of both airplanes and organizations. This conceptual model of dynamic organizational fit, as another instance, also highlights an important, mutually inhibiting interrelationship between stability and maneuverability, and it illuminates the potentially enabling role of technology in terms of moderating such interrelationship. The extended conceptual model, as a third instance, includes operationalized constructs that suggest an approach to empirical measurement of the key concepts, and we further identify instability and unmaneuverability penalties with corresponding opportunity losses in terms of dynamic stability and maneuverability.

This extended conceptual model of dynamic organizational fit, particularly with its operationalized constructs, outlines a theory-based framework that appears suitable for empirical testing. Toward this end, we illustrate its use through empirical application to a very complex inter-organizational case involving thousands of participating organizations attempting to provide multinational relief following the 2004 Indian Ocean disaster. We instantiate the dynamic organizational fit model using details from the case, and we illustrate how poor fit of the inter-organizational collectivity with its environment can be delineated and measured in terms of dynamic instability and opportunity loss. We further characterize some important implications of poor inter-organizational fit through human death and suffering, and we identify several topics for continued research along the lines of this investigation.

For one, our airplane-organization analogies are kept purposefully very simple to illustrate the key points of comparison and insight. Given the considerable sophistication and empirical power of Aerospace Engineering, more complex applications (e.g., nonlinear motion, continuous time, multiple variables) are straightforward to conceive, and they offer potential to enrich the discussion in practical as well as theoretical ways. One must remain vigilant, however, and resist the temptation to treat organizations with the same degree of rigor and predictability as organisms.

For another, it remains unclear what kinds of technologies offer potential to moderate the mutually inhibiting interrelationship between stability and maneuverability. If information or like technology exists that enables highly unstable—and highly maneuverable—inter-organizational collectivities to be controlled, or at least not fly out of control, then such technology would offer potential to design whole new classes of organizations and inter-organizational collectivities. Relatively recent yet still developing organization theory covering ambidextrous organizations, resilience capacity, organizational semistructures, Edge organizations, dynamic capabilities and other approaches offer potential to elucidate the stability-maneuverability conundrum as well, and our dynamic organizational fit model may prove useful in terms of guiding and complementing research along such lines.

As with every study, the present investigation has several limitations. Our dynamic organizational fit model remains relatively novel and primitive; hence it can benefit from considerable refinement and extension. Also, our application of the model to the tsunami relief efforts illustrates only one of many possible cases that could be used to instantiate the model and compare different inter-organizational designs in terms of stability, maneuverability, performance and like constructs; hence incorporation of and comparison with additional cases offers potential for increased insight, both into the dynamic fit model and inter-organizational design in the context of multinational disaster relief. Application of the dynamic organizational fit model to other, organizational and inter-organizational designs and contexts represents a wide open avenue for continued research along these lines as well, particularly empirical work to refine and measure the key dynamic fit constructs (esp. *dynamic stability, maneuverability, opportunity loss*). The research described in this article highlights ample potential for refinement and extension. We're eager to continue this work, and we welcome others to join us.

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LIST OF REFERENCES

Ackoff, R. L. (1971). Toward a systems of systems concepts. *Management Science, 17*(11), 661-671.

Alberts, D. S., & Hayes, R. E. (2003). *Power to the edge : Command and control in the information age*. Washington, DC: Command and Control Research Program.

Arciszewski, H. F. R., de Greef, T. E., & van Delft, J. H. (2009). Adaptive automation in a naval combat management system. *IEEE Transactions on Systems, Man and Cybernetics, Part A, 39*(6), 1188-1199.

Argote, L. (1982). Input uncertainty and organizational coordination in hospital emergency units. *Administrative Science Quarterly, 27*(3), 420.

Beer, S. (1966). *Decision and control: The meaning of operational research and management cybernetics*. Chichester: John Wiley & Sons.

Brown, S. L., & Eisenhardt, K. M. (1997). The art of continuous change: Linking complexity theory and time-paced evolution in relentlessly shifting organizations. *Administrative Science Quarterly, 42*(1), 1.

Burns, T., & Stalker, G. M. (1961). *The management of innovation*. London: Tavistock Publications 1966, c.

Burton, R. M., DeSanctis, G., & Obel, B. (2006). *Organizational design : A step-by-step approach*. Cambridge, UK; New York: Cambridge University Press.

Burton, R. M., Lauridsen, J., & Obel, B. (2002). Return on assets loss from situational and contingency misfits. *Management Science*, *48*(11), 1461.

Checkland, P. (1981). *Systems thinking, systems practice*. New York, NY: Wiley.

Ciborra, C. U. (1996). The platform organization: Recombining strategies, structures, and surprises. *Organization Science*, *7*(2), 103.

Comfort, L. K. (2006). Asymmetric information processes in extreme events: The 26 december sumatran earthquake and tsunami. In D. Gibbons (Ed.), *Communicable crises: Prevention, management and resolution in an era of globalization* (). Monterey, CA: International Public Management Association.

Davidow, W. H., & Malone, M. S. (1992). *The virtual corporation : Structuring and revitalizing the corporation for the 21st century* (1st ed.). New York: Edward Burlingame Books/HarperBusiness.

Donaldson, L. (1987). Strategy and structural adjustment to regain fit and performance: In defence of contingency theory. *The Journal of Management Studies*, *24*(1), 1.

Donaldson, L. (2001). *The contingency theory of organizations*. Thousand Oaks, Calif: Sage Publications.

Eisenhardt, K. M., & Martin, J. A. (2000). Dynamic capabilities: What are they? *Strategic Management Journal*, *21*(10/11), 1105.

Fan, X., McNeese, M., Sun, B., Hanratty, T., Allender, L., & Yen, J. (2010). Human-agent collaboration for time-stressed multicontext decision making. *IEEE Transactions on Systems, Man and Cybernetics, Part A, 40*(2), 306-320.

Feigenbaum, D. (1968). The engineering and management of an effective system. *Management Science, 14*(12), 721-730.

Gateau, J. B., Leweling, T. A., Looney, J. P., & Nissen, M. E. (2007). Hypothesis testing of edge organizations: Modeling the C2 organization design space. *Proceedings International Command & Control Research & Technology Symposium,* Newport, RI.

Gopinath, C., & Sawyer, J. E. (1999). Exploring the learning from an enterprise simulation. *The Journal of Management Development, 18*(5), 477.

Gresov, C., & Drazin, R. (1997). Equifinality: Functional equivalence in organization design. *The Academy of Management Review, 22*(2), 403.

Gresov, C., Drazin, R., & Van de Ven, A. H. (1989). Work-unit task uncertainty, design and morale. *Organization Studies, 10*(1), 45.

Hamilton, R. T., & Shergill, G. S. (1992). The relationship between strategy-structure fit and financial performance in new zealand: Evidence of generality and validity with enhanced controls. *The Journal of Management Studies, 29*(1), 95.

Houghton, E. L., & Carruthers, N. B. (1982). *Aerodynamics for engineering students* (Third ed.). London: Edward Arnold.

Ibrahim, R., & Nissen, M. (2007). Discontinuity in organizations: Developing a knowledge-based organizational performance model for discontinuous membership. *International Journal of Knowledge Management, 3*(1), 10.

Johnson, R. A., Kast, F. E., & Rosenzweig, J. E. (1964). System theory and management. *Management Science, 10*(2), 367-384.

Kast, F., & Rosenzweig, J. (1972). General systems theory: Applications for organization and management. *Academy of Management Journal, ,* 447-465.

Kauffman, S. A. (1995). *At home in the universe: The search for laws of self-organization and complexity*. New York, NY: Oxford University Press.

Keller, R. T. (1994). Technology-information processing fit and the performance of R&D project groups: A test of contingency theory. *Academy of Management Journal, 37*(1), 167.

Lawrence, P. R., & Lorsch, J. W. (1967). *Organization and environment; managing differentiation and integration*. Boston, Division of Research, Graduate School of Business Administration: Harvard University.

Lengnick-Hall, C. A., & Beck, T. E. (2005). Adaptive fit versus robust transformation: How organizations respond to environmental change. *Journal of Management, 31*(5), 738.

Levitt, R. E., Thomsen, J., Christiansen, T. R., & Kunz, J. C. (1999). Simulating project work processes and organizations: Toward a micro-contingency theory of organizational design. *Management Science, 45*(11), 1479.

Meyer, A. D., Tsui, A. S., & Hinings, C. R. (1993). Configurational approaches to organizational analysis. *Academy of Management Journal*, *36*(6), 1175.

Miles, R. E., & Snow, C. C. (1978). *Organizational strategy, structure, and process*. New York: McGraw-Hill.

Mintzberg, H. (1979). *The structuring of organizations : A synthesis of the research*. Englewood Cliffs, N.J: Prentice-Hall.

Mohr, L. B. (1971). Organizational technology and organizational structure. *Administrative Science Quarterly, 16*(4), 444.

Nissen, M. E., & Burton, R. M. (2011). Designing organizations for dynamic fit: System stability, maneuverability and opportunity loss. *IEEE Transactions on Systems, Man and Cybernetics, Part A, 41*(4)

Nissen, M. E., & Levitt, R. E. (2004). Agent-based modeling of knowledge dynamics. *Knowledge Management Research & Practice, 2*(3), 169.

Nissen, M. E., & Leweling, T. A. (2008). Conceptualizing dynamic organizational fit in multicontingency contexts. *Proceedings Academy of Management Conference,* Anaheim, CA.

Ouchi, W. G. (1980). Markets, bureaucracies, and clans. *Administrative Science Quarterly, 25*(1), 129.

Pennings, J. M. (1975). The relevance of the structural-contingency model for organizational effectiveness. *Administrative Science Quarterly, 20*(3), 393.

Sabherwal, R., Hirschheim, R., & Goles, T. (2001). The dynamics of alignment: Insights from a punctuated equilibrium model. *Organization Science, 12*(2), 179.

SAS-065. (2008). *The indian ocean tsunami: The case of aceh and north sumatra* No. NATO RTO SAS-065 Part Two). Washington, DC: CCRP.

SAS-065. (2010). *NATO NEC C2 maturity model* No. SAS-065). Washington, DC: CCRP.

Sauser, B., Boardman, J., & Verma, D. (2010). Systomics: Toward a biology of system of systems. *IEEE Transactions on Systems, Man and Cybernetics, Part A, 40*(4), 1083-4427.

Schulze, K. E. (2006). *Between conflict and peace: Tsunami aid and reconstruction in aceh*

Scott, W. R. (2003). *Organizations : Rational, natural, and open systems* (5th ed.). Upper Saddle River, N.J: Prentice Hall.

Sharpe, J., & Wall, I. (2007). *Media mapping - understanding communication environments in aceh* No. Indonesian Social Development Paper No. 9)The World Bank.

Sinha, K. K., & Van de Ven, A. H. (2005). Designing work within and between organizations. *Organization Science, 16*(4), 389-408.

Sterman, J. D. (2000). *Business dynamics: Systems thinking and modeling for a complex world*. Boston MA: Irwin/McGraw-Hill.

Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic Management Journal, 18*(7), 509.

Telford, J., & Cosgrave, J. (2006). *Joint evaluation of the international response to the indian ocean tsunami: Synthesis report*. London: Tsunami Evaluation Coalition.

Tushman, M. L., & O'Reilly, C. A.,III. (1999). Building ambidextrous organizations: Forming your own "skunk works". *Health Forum Journal, 42*(2), 20.

von Bertalanffy, L. (1969). *General systems theory*. New York: George Braziller.

Whittington, R., & Pettigrew, A. M. (2003). Complementarities, change and performance. In A. M. Pettigrew, et al. (Eds.), *Innovative forms of organizing* (). London: Sage.

Woodward, J. (1965). *Industrial organization: Theory and practice*. London, New York: Oxford University Press.

Yu, F., Tu, F., & Pattipati, K. R. (2008). Integration of a holonic organizational control architecture and multiobjective evolutionary algorithm for flexible distributed scheduling. *IEEE Transactions on Systems, Man and Cybernetics, Part A, 38*(5), 1001-1017.

Zajac, E. J., Kraatz, M. S., & Bresser, R. K. F. (2000). Modeling the dynamics of strategic fit: A normative approach to strategic change. *Strategic Management Journal, 21*(4), 429.

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