2009

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Recommended Citation (OVERRIDE)
Kimberly, J.R. & Rye, C.B. (2009) In Bhagat, R.S. & Steers, R.M. (Eds.), *Cambridge Handbook of Culture, Organizations, and Work*, (pp. 197-215). New York, Cambridge University Press.

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Abstract

The relationship between culture and innovation has intrigued researchers for generations. After much research and experimentation, what we know about the relationship is that innovation both shapes and is shaped by culture, and that both culture and innovation can be conceptualized as operating at multiple levels - national, regional, and organizational. We also know that in the management literature, culture has most commonly been conceptualized as an organizational variable - a constellation of norms and values, unique in some respects to every organization, that can, through its influence on behavior of organizational members, either encourage and facilitate innovation or be an obstacle to it.

Disciplines

Organizational Behavior and Theory | Technology and Innovation

CHAPTER 8 Cultural variations and the morphology of innovation

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The relationship between culture and innovation has intrigued researchers for generations. After much research and experimentation, what we know about the relationship is that innovation both shapes and is shaped by culture, and that both culture and innovation can be conceptualized as operating at multiple levels – national, regional, and organizational. We also know that in the management literature, culture has most commonly been conceptualized as an organizational variable – a constellation of norms and values, unique in some respects to every organization, that can, through its influence on the behavior of organizational members, either encourage and facilitate innovation or be an obstacle to it.

The focus in this handbook is on culture, organizations, and work. But what happens when we focus on the adoption and diffusion of innovation and seek to understand the role of culture in that process? We find that research on innovation has generally been concerned with one of two general classes of problems: the *production* of innovation or the *diffusion and adoption* of innovation. Culture is frequently invoked by researchers to explain either why one organization produces more innovations than another or why one organization adopts a given innovation whereas another either does not or adopts later than the other. And when managers wish to increase the "innovativeness" of their organizations in either of the senses noted above – production or adoption – they often introduce initiatives designed to change the culture in the belief that the sort of behavioral change they seek will follow. When conceptualized this way, culture is seen primarily as an organizational attribute that varies measurably from one organization to the next.

But what about the influence of national or regional culture on innovation? We see many fewer studies of its relationship to innovation. Perhaps this is because it seems less tractable than organizational culture; or because, by focusing on only one country, most work on innovation effectively holds national and/or regional culture constant; or because of the research challenges that inevitably complicate cross national research. But, as the work of Guillen and others (Guillen, 2000; Guler, Guillen, and Macpherson, 2002; Polillo and Guillen, 2005) has shown, differences in national culture are related to differences in innovation. And in an era when the flow of people, ideas, and other resources across national borders is accelerating rapidly, we might expect that the level of interest in the relationship between national or regional culture and innovation would increase.

In this chapter, we are concerned with the adoption and diffusion of innovation across national borders, and we seek to clarify the influence of national and regional culture on this process. This effort has led us to see innovation differently from the way it is typically seen in the adoption and diffusion literature and to focus on what we call the *morphology of innovation*, or the way in which innovation may change as it spreads across national and regional borders. The most common research approach in the adoption and diffusion literature seeks to explain the propensity and timing of the adoption of an innovation. Typically, this research identifies those organizational characteristics that are thought to influence adoption, explores how these characteristics vary in the population of

[1] We are grateful to Jon Chilingerian for his comments on this chapter, and we thank Gérard de Pouvourville, Tom D'Aunno, and the authors of the chapters used in the preparation of this manuscript for their contributions. All errors and omissions are our own.

interest, and then examines how this variability is related to variability in adoption behavior. In this approach, organizations are the unit of analysis, and innovations are generally considered to be discrete objects or sets of practices. The influence of national or regional culture is rarely considered explicitly.

Research using this approach has two principal limitations, neither of which is obvious because both are implicit. First, one underlying assumption is that innovations are both discrete and static; perhaps this is because the organization is the unit of analysis and, as such, the dynamic characteristics of innovation have been overlooked, or perhaps it is because many of the innovations that have been researched, such as MRI machines or computers, are technologically embedded and at a superficial level appear to be fixed, concrete entities. Second, because the underlying assumption is that innovations do not change as they diffuse, research using this approach overlooks the possible influence of national or regional culture on the shape of innovation itself.

How might these limitations be addressed? We suggest that instead of looking at innovation and culture from an organizational perspective, where the organization is the unit of analysis, one might explore the way in which an innovation moves across national and regional borders and becomes incorporated in organizations as a function of varying institutional arrangements, historical circumstances, and power distributions. In other words, rather than assuming that innovations are discrete and static, one might explore whether and to what the extent innovations evolve and change as they diffuse and are implemented in different national and regional contexts, partly as a function of institutional, historical, and political differences in these contexts and partly as result of accumulation of experience with their use. In this approach, the innovation itself is the unit of analysis. Culture shapes the innovation, and this – along with the cultural values embedded in organizations – shapes implementation and, ultimately, diffusion.

We adopt this approach in the research we report in this chapter. We explore the relationship between national and regional culture and the ways in which innovation changes as it diffuses and is implemented. Specifically, we analyze cross-national data on the diffusion and implementation of an important innovation – patient classification systems (PCSs) – and examine how national culture shapes the way in which groups of stakeholders have modified this innovation to fit national and regional contexts. We then discuss the research implications of this view of the process.

Based on our analysis, we develop the concept of the *morphology of innovation*, or the way in which innovation changes as it spreads across national and regional borders. Our analysis leads us to conclude that *the implicit assumption that innovations are discrete, unchanging and culture-free, an assumption that is common in the adoption and diffusion literature, needs to be reevaluated.* Rather, many innovations are not discrete, change as they spread, and are culturally embedded. The case of patient classification systems suggests that rather than assuming that innovations are static, we need to consider the possibility that they are dynamic and, specifically, be aware of the fact that innovations are infused with cultural values that may evolve and change over time in accordance with the *logiques d'action* of influential stakeholders, those principles by virtue of which individuals and groups organize their behavior (Karpik, 1972). Although some innovations certainly evolve and change more than others as they diffuse, the exceptional case may in fact be the innovation that doesn't change at all.

A short history of patient classification systems

Patient classification systems (PCSs) are tools for comparing the outputs of health care providers. The first PCS was developed by a team of researchers at Yale University under the direction of Robert Fetter and John Thompson in the 1960s and 1970s. After a group of local physicians asked the team for help with utilization review in 1967, they experimented with industrial engineering techniques and assessed whether they were feasible in a hospital setting, where tens of thousands of unique hospital patient types existed (Chilingerian, 2008).[2] The team searched for an underlying structure to resource consumption that, at the same time, had clinical coherence. To this end, they applied the techniques of statistical process control to focus on similarities and used physician panels to understand clinical patterns (*ibid.*).

Based on this analysis, the Yale team eventually developed computer software, called grouper software, that would subdivide large datasets of patient records with cost data into meaningful categories from a resource and clinical perspective, an algorithm for so doing, and associated tools such as a cost modeling system. Specifically, they segmented 10,000 hospital diagnostic codes into twenty-three mutually exclusive, exhaustive categories called major diagnostic categories (MDCs), based on major organ systems inferred from diagnosis. They then segmented MDCs by three variables they found to be strongly associated with resource consumption – presence of a surgical procedure, presence of complications or co-morbidities, and patient age – in a decision tree structure (*ibid.*). The resulting categories, or diagnosis related groups (DRGs), were designed to segment clinically similar groups of patients by their resource requirements in hospital settings and provided a way – for the first time – to measure and compare the output of hospitals (*ibid.*).

On April 1, 1983, the US Congress adopted DRGs as a financing tool for Medicare hospital payments (Kimberly, D'Aunno, and Pouvourville, 2008). Under the US Prospective Payment System, DRGs are the underlying patient classification system, and Medicare prospectively pays hospitals a flat amount per patient diagnosis, which falls into one of over 500 DRG categories (CMS, 2007). DRGs were adopted in the hopes that prospective payment would promote cost control relative to the fee-for-service system that was previously in place. Significantly, the US was one of many countries struggling with increasing healthcare costs, and over time several other countries experimented with and adopted PCSs (Kimberly, D'Aunno, and Pouvourville, 2008). Implementation was earliest in a number of countries in western Europe, but followers have included developed countries around the globe. Countries implemented PCSs for various purposes – financing (as in the US), but also as managerial, epidemiological, and planning tools.

Implementation within adopting countries has varied considerably, with much regional variation. For example, by 1991, twenty American states had adopted DRGs, and, by 1997, the US government reported eighteen different PCSs in use in the states for Medicaid and other payments (Chilingerian, 2008).[3] In Australia, the state of Victoria adopted a PCS first, and other states followed its lead, in both adoption and changes to the PCS (Duckett, 2008). And in Italy there has been substantial variation across regions in the adoption and implementation of disease classification schemes and DRG classification versions, although a law compelled them to adopt a uniform disease classification system in 2006, which also implied a shift to a new DRG classification system (Tedeschi, 2008).

Research methods

To examine the relationship between national and regional culture, innovation, and organization, we took the innovation – patient classification systems – as the unit of analysis and tracked how they evolved and changed over time, as well as why this happened. This way of framing the relationship differs from the more common research approach, that takes the organization as the unit of analysis and explores how variability at the organizational level influences adoption and implementation of a particular innovation and that implicitly assumes that the innovation is invariant across contexts.

Data collection began with a unique database of the histories of PCS adoption and implementation within sixteen countries. This database consisted of a series of book chapters, each describing the history of one country's experience with PCS, taken from a project designed to examine

[2] For example, Chilingerian (2008) reports that there were thirty-nine different ways to describe a cataract care process.

[3] DRGs are used in the same way across the US for Medicare payments, since Medicare is a federally sponsored program.

the crossnational diffusion of PCS (Kimberly, D'Aunno, and Pourvourville, 2008). Since process-oriented research questions require longitudinal research designs (Kimberly, 1976), it was imperative to have longitudinal data, which the histories provided. It was also desirable to have rich description to facilitate theory building, as well as accounts from individuals with first-hand experience of the events to increase validity of the data. The histories had these characteristics as well.

We selected a subset of these histories for inclusion in our study using theoretical sampling (Eisenhardt, 1989). Specifically, we selected countries so that they exhibited variation on a set of pre-specified characteristics, such as timing of initial adoption of PCS, timing of changes in PCS use, resulting use of PCS, and national context. The resulting subset of countries includes the US, France, Italy, Japan, and Germany. Table 8.1 delineates some salient characteristics of PCSs in these countries.

To analyze our data, we used grounded theory techniques (Glaser and Strauss, 1967; Strauss and Corbin, 1998; Strauss, 1987). Specifically, we coded country histories for categories of data related to: (i) important events in PCS adoption; (ii) factors shaping PCS adoption; (iii) characteristics of PCS; and (iv) what PCS means to the focal country. This code structure emerged from the data. We developed the code structure iteratively and, when a category was added for one country, we then revisited and coded all other countries for that category. We then iteratively developed codes within each of these categories across countries, as they emerged from the data (grouping, for example, PCS characteristics mentioned in the histories that were similar to each other on one or more dimensions). We completed these steps in NVIVO 7 (QSR International, Melbourne, Australia).

After these steps, we transferred and re-coded selected data into an Excel database to enable us to analyze the categories in the context of time, key to analysis of process (Kimberly, 1979). Specifically, we induced phases of innovation adoption and change based on the analysis of important events and then re-coded categories three and four by phase.[4] For example, we tracked the components of innovation, as they existed in each country in each country's phases of innovation adoption and change. Additionally, we induced more detailed categories of factors shaping PCS development and coded them into an Excel database, enabling us to compare these factors across countries more easily.

A different view of innovation

Based on this analysis, we see innovation as a complex of components that may change as a function of the differential interests of influential stakeholders, platforms for action that are situated in institutional, historical, and political contexts. This view differs from most previous research, in which innovation is typically viewed as a more or less discrete entity as opposed to a changing complex of components, and institutional, historical, and political contexts as correlates of adoption of innovation as opposed to drivers of change in innovation configuration. Specifically, across the countries in our sample, we found that the basic components of PCS were similar. Further, innovation expanded over time in both breadth (number of components) and depth (number of elements of components) in predictable ways at this macro level of analysis. However, at a micro level of analysis, there was substantial variation, particularly in the ways in which components "looked" in each of the countries (or, types of elements in each component) and how components related to each other. This variation unfolded over time, reflecting the interests and agendas of influential stakeholders, often unique to each country and region.

In other words, as the innovation was adopted and implemented across countries and regions within countries, rather than being stable, the components of innovation changed. At a macro level of analysis, components expanded in breadth and depth in ways that were homogeneous across countries. At a micro level of analysis, components also changed in content and in their relationship to each other in ways that were heterogeneous across countries. We have come to call the process by

[4] Not enough information was provided in the histories to code category two reliably by phase.

Table 8.1. Variation in patient classification system adoption

Country	Year of Adoption	Origin of System	Goals and Purpose of the System	Difficulty/Duration of Adoption and Implementation	Extent of System Use
France	1982–1989 – US DRG research projects. 1986 – French DRG project-French grouper based on HCFA 1985 DRG system. 1994 PMSI implemented. 1996 – Full data, 1998 productivity report available. 1997–1998 – Discharge data recorded.	US Yale systems, with adaptation and refinements.	Financing hospitals (recent goal).	*Difficult* Conflicting policy, different payment rules for for-profit and non-profit providers.	Acute hospital care (medical, surgical, and obstetrics).
Germany	2005 – DRGs introduced in phases, beginning in 2002; much preparation work completed earlier.	Australian DRG system; Australian procedure code mapped to German code.	Increase hospital efficiency; contain health spending; reduce length of stay.	*Moderate* Change to DRGs was phased in; idea considered much earlier than 2002; stakeholders have varying views.	All hospital activity.
Italy	1994 – Capitation Act and related funding. 2002 – Italian version of ICD9-CM codes.	Based on US model.	Financial system to control growth of hospital costs, increase accountability for production.	*Difficult* 1994 to 2002 choppy uptake, differences among regions in diffusion and use/regional autonomy.	Inpatient hospital activity. Extends to nursing homes.
Japan	2001 – International scan and study for a case mix system. 2003 – Implemented for payment using ICD-10 codes.	Influenced by French and Australian systems for regional health planning and Belgium and Britain for incremental development.	Process oriented to reflect medical practice; hospital profiling and improved efficiency.	*Moderate* Incremental rollout. Strong IT system development, still opposition from physicians and hospitals.	Acute hospital care.
United States	1967 – Yale University research project based on ICD codes of 10,000 diagnoses then organized into 383 cases. 1980–1982 – 72 hospitals in New Jersey came under DRG payment. 1983 – Congressional law using DRGs as payment for Medicare beneficiaries.	Length of Stay as a standard measure; DRGs identified as the 'product of the hospital'.	Expected cost of hospital case mix. Government healthcare budget control tool.	*Moderate* 1980–1982 – New Jersey hospitals. 1983–1994 – diffused to every region in the US. 1991 – 20 states using DRG-based payment systems.	Inpatient care for Medicare beneficiaries (government sponsored health insurance for individuals over 65 years or disabled). 1992 – prospective payment system. 1997 – extended to outpatient, skilled nursing, long-term care, home care and rehabilitation. Current – APR-DRGs development of refined DRGs to capture severity and risk of mortality.

Source: Kimberly, D'Aunno, and Pourvourville (2008b).

which components and elements of an innovation change over time the *morphology of innovation*.

The components of PCS

We define *component* as a basic constituent of an innovation. In our taxonomy, components are composed of *elements*, or distinct parts of a component. In the case of PCS, components were similar across countries. Specifically, we found that the components are: (i) information; (ii) physical artifacts; (iii) knowledge; (iv) processes; and (v) organizational arrangements. Table 8.2 lists examples of elements of these components for each country in the sample. We explore each of these components in turn below.

Information

All countries in the sample began their adoption process with information, and information continued to drive the shape of the innovation over time. By information, we mean to include what some have called explicit knowledge, or "knowing about" how to do something (Grant, 2003). Specifically, information includes items such as research on the validity of other countries' PCSs in the focal country context or cost data collected from hospitals. For example, in Japan, the Ministry of Health, Labor, and Welfare (MHLW) conducted research on the validity of three different PCS alternatives early in the innovation's history within that country. They compared already existing PCSs and an early version of a new PCS, developed for Japan, to see if they were applicable to the Japanese hospital system and patterns of clinical practice found there. This research drove early discourse about PCS, which, when powerful physician stakeholders expressed concern that outside systems would curtail their medical practice, led to more MHLW research on PCS application in several European countries. The latter research eventually informed efforts to build an original PCS, based on Japanese clinical practice and process (Matsuda, 2008).

Physical artifacts

Countries in our sample developed the tools necessary for experimenting with and implementing a PCS. These include items such as databases, coding manuals, and software systems. While tools were developed, information about PCS continued to accumulate, sometimes within the physical artifacts (e.g. manuals) and sometimes through expanded efforts to compare other countries' experiences with the focal countries' circumstances. For example, between 1982 and 1985, France developed a pilot medical records database to test the creation of a French hospital database, a uniform hospital discharge dataset, and a computer system for assessing the technical feasibility of assigning DRG codes to uniform hospital abstracts (the Grenoble-based DOSTAM system). Some were part information, part physical artifact (e.g., the uniform hospital discharge dataset), but all contained tactile elements. All were necessary for the creation of a French PCS, which was adapted from the US system (Rodrigues and Michelot, 2008).

Knowledge

While agents in countries developed physical artifacts, and as artifacts came to be used in implementation of PCSs, knowledge began to accumulate. By knowledge, we mean what others have called tacit knowledge, or "knowing how" (Grant, 2003; Polanyi, 1962). Specifically, knowledge includes elements such as the coding know-how of hospital employees and the development know-how of government officials building physical artifacts. While knowledge builds, information and physical artifacts continue to accumulate as the country implements PCS, and, over time, some knowledge converts to information as it is codified. The French experience with PCS provides a good example of knowledge building. When France began experimenting with PCS, French hospitals did not have personnel trained to handle diagnosis and procedure coding, an essential component of PCS, and had never been legally compelled to register data on medical services provided, unlike hospitals in other countries. Both skills require a good bit of tacit knowledge. Once the tools required for experimentation with PCS were developed, people began to gain experience with coding and registration of services, and collectively built an infrastructure of knowledge on how to do those things. Eventually, most universities developed curricula in medical information (Rodrigues and Michelot, 2008).

Table 8.2 Innovation components and selected elements

Innovation Components and Selected Elements	United States	France	Italy	Japan	Germany
Information					
Research on validity of other alternatives	X	–	–	X	X
Research on validity of concept	X	X	X	X	–
Positive and negative lists	–	–	X	–	–
Patient data from hospitals	X	X	X	X	X
Cost data from hospitals	X	X	X	X	X
Physical Artifacts					
Grouper	X	X	X	X	X
Pilot medical records database	X	X	X	X	X
Uniform hospital discharge dataset	X	X	X	X	X
Information systems to help with coding	–	–	–	X	–
Information systems to enable payment	–	–	–	X	–
Costing manual	–	–	–	X	–
Software for costing studies	–	–	–	X	–
Knowledge					
Expertise in grouper software	X	X	X	X	X
Organizational expertise in coding	X	X	X	–	X
National education program in coding	–	X	–	–	–
Org expertise in managerial uses	–	–	–	X	–
Processes					
Classification system	X	X	X	X	X
Payment system	X	X	X	X	X
Cost accounting model	X	X	X	–	X
Budgeting model	–	X	–	–	–
Organizational Structure					
Governmental committees to evaluate PCS	X	X	X	X	–
Creation of departments within organizations	–	X	–	–	–
Creation of governmental agency	–	X	–	–	X
Committee of associations to evaluate PCSs	–	–	–		X
Creation of other PCS institutions	–	–	–	–	X

Processes

Usually at the same time as physical artifacts were developed, developers chose processes necessary for PCS. In particular, these processes included cost modeling systems, classification systems, and payment systems. For example, a committee in the Reagan administration was charged with developing the DRG approach and, eventually, recommended this approach to Congress. They developed a payment system, which Congress approved, whereby a hospital's DRG payment was calculated as follows: hospital's payment per discharge = DRG relative weight * standardized base payment. In its basic form, Medicare creates a standardized base payment rate (BP) that includes operating and capital costs which represents a national average unit price for medical care. Then, each DRG is assigned a relative weight (RW) that represents the expected resource consumption for a typical patient at an average hospital (Chilingerian, 2008).[5] Hospitals are paid the product of these two numbers for each diagnosis in each DRG, adjusted for geographic and organizational characteristics. By contrast, in Japan, there are two components of reimbursement – a per diem hospital fee (paid using the Japanese PCS) and a fee-for-service component (paid for surgical procedures and anesthesia, pharmaceuticals and expensive devices, and procedures that cost more than 10,000 yen / US $100). The per diem hospital fee is paid on a sliding scale depending on the amount of time that patients are in the hospital.[6] Further, a hospital coefficient is applied and calculated according to function and characteristics of the hospital facility (Matsuda, 2008).

Organizational arrangements

Finally, experimentation with and implementation of PCS required new organizational arrangements in all of the countries in our sample. This includes elements such as new committees, new governmental agencies, and new departments within hospitals. These are considered part of the innovation, because the innovation could not be developed or used without them. Importantly, as before, other components continued to change and expand as organizational arrangements developed. The French, for example, mandated that hospitals create medical records departments and created a national casemix agency (Rodrigues and Michelot, 2008). The Department of Planning at the Ministry of Health in Italy created a committee to study patient discharges from a sample of Italian hospitals to assess feasibility of PCS (Tedeschi, 2008).

[5] For example, a DRG with a relative weight of 1 is expected to consume half of resources as a DRG with a relative weight of 2 (Chilingerian, 2008).

[6] Up to a length of stay equaling the twenty-fifth percentile day in Japan for that diagnosis, the per diem rate is 15 percent more than a national standard per diem rate. However, from the day corresponding to the average length of stay in Japan for that diagnosis to that length of stay plus two standard deviations, the per diem rate is set for 15 percent less than the standard per diem rate (Matsuda, 2008).

Changes in components over time

One can see from table 8.2 that all countries in our sample possessed these basic components of PCS. However, it is clear that the elements of innovation within each component varied. For example, while research on the validity of other alternatives (including other existing PCSs, flat rate payment, etc.) shaped the resulting PCS in the US, Japan, and Germany, such research was less important in France and Italy. To take another example, while all countries developed knowledge, countries differed as to what types of knowledge were developed. Employees in French hospitals were not used to handling international coding systems and, as a result, lacked coding skills and needed to develop this expertise as part of PCS implementation. The US had a deep history of coding and registering diagnoses and procedures. However, developers had to gain tacit expertise in partitioning cost and procedure data.

It is less clear from table 8.2 that, while some elements appear to be similar, they may be used and/or adopted quite differently. For example, all countries in the sample adopted some form of a grouper, which is a basic tool required for the use of PCS. However, France transposed the American grouper, while Germany transposed the Australian grouper. All countries in the sample adopted some form of a classification system. However, the US, Japan, and France developed their own systems, while Germany adopted the Australian system (and Italian regions each adopted or developed different systems). While all countries in our sample eventually developed a payment process, the US adopted one in 1983, three years after the first demonstrated use of PCS as a payment mechanism (in the state of New Jersey), while France did not adopt one until 2004 – nineteen years after the release of the first French classification system and twenty-five years after the first demonstrated use in New Jersey.

Clearly, though it appears similar at a macro level of analysis, when viewed at a micro level of analysis PCS differs between adopting countries and, sometimes, between regions within adopting countries. The granularity of the micro level is not trivial, as adoption of elements such as a payment system, and choice in which payment system to adopt or develop, has significant consequences for how an innovation "looks" and functions – and diffuses.

So how exactly does PCS vary between countries, and how did this variation unfold over time? Table 8.3 shows how innovation elements changed over time in the first two adopters of PCS – the US and France (similar tables for other countries available from the authors upon request). Each line corresponds to one element of PCS and lists the year when it was adopted, developed, or changed; regional events and the type of component are denoted in each line, according to the table index.

In particular, it is clear that, as PCS diffused to countries and to regions within countries, the innovation expanded over time in breadth (number of components) and depth (number of elements of components). Concretely, in the US, a classification system and a grouper – two basic physical artifacts necessary for using a PCS – were developed early in the country's experience with PCS. However, once built, several committees (organizational arrangements) convened to build evidence on the validity of PCS (information), and hospital expertise with coding and governmental expertise with updating DRGs began to accumulate (knowledge). Over time, the innovation expanded to new settings based on accumulated information and knowledge (such as physician services in 1992) with new corresponding processes (here, the resource-based relative value scale, or RBRVS, for payment process for physician services) and new corresponding needs for information (here, collection of new cost data) (Chilingerian, 2008). In contrast, the French transposed the American classification system based on consulting assistance from the Yale team and information gathered from the US (information) and then, over time, developed proprietary versions (physical artifacts, processes) based on continued research (information). Employees in French hospitals gathered expertise in coding through pilot projects (knowledge) and, once a governmental decree mandated the establishment of medical records departments (organizational arrangements), this became part of routines in hospitals (additional knowledge). Over time, processes changed to accommodate the government's intended use of the innovation (process); in particular, payment systems were developed only in the past several years when the government decided to use PCS as a financing tool for French hospitals (Rodrigues and Michelot, 2008).

As the components gradually expanded over time in breadth and depth, they also changed in meaning. This was visible in substantial variation over time in the types of elements in each component and how components related to each other. One can begin to see this in table 8.3. For example, the classification system first developed in France grew to become "more French" over time as developers moved from an American transposition in 1986 and created a proprietary classification system fitted to clinical practice patterns in France in 1996. The basic system of classification in the US, first used in hospitals from 1983, eventually expanded in 1992 and 1997 to include settings as diverse as physician services, outpatient services, skilled nursing care, long-term care, home health care, and rehabilitation services. Physical artifacts, organizational arrangements, processes, information, and knowledge expanded and changed to accommodate PCS in these new settings. For example, the grouper software was modified for new settings and operated on new kinds of cost data.

The data from these five countries lead us to speculate that changes in the meaning of innovation during diffusion were driven by the interests and agendas of influential stakeholders. The early US experience illustrates this process. Specifically, the original PCS developed by Fetter and Thompson at Yale was designed as a managerial tool for utilization review. Chilingerian (2008) notes that DRGs came to be adopted in the US not because the approach offered a perfect technical policy solution, but because the approach became closely aligned with the socio-cultural and political systems. In fact, there were several other alternative schemes designed as financing tools (for example, flat rates and price controls). However, New Jersey Health Commissioner Joanne Finley – former New Haven city public health officer, adjunct professor at Yale, and associate of Thompson – was faced with rising health-care costs and pressure from lawsuits to reform. In this midst of this, she remembered Thompson's innovation and encouragement to "try this new thing." In 1976, she requested a proposal

Table 8.3 Innovation elements over time in the United States and France

Year	United States	France
1967	Yale team begins work on PCS (OS)	
Early 1970s	Classification system (DRGs) (P)	
Early 1970s	Grouper and tools developed (PA)	
Early 1970s	System expertise builds at Yale team level (K)	
1976	*R:* Proposal for all-payer DRG system in NJ (I)	
1979	Pettengill and Vertrees committee conducts pilot (OS)	
	Pettengill and Vertrees report on DRGs (I)	
1980	Schweiker committee forms (OS)	
	R: 26 NJ hospitals receive DRG payments (P, PA)	
	R: System expertise builds at organizational level (K)	
1981	Schweiker report on DRGs and flat rates (I)	
	R: 40 more NJ hospitals receive DRG payments (P, PA)	
	R: System expertise builds at organizational level (K)	
1982	Report to Congress proposing DRGs (I)	Visit of French delegation to Yale (I)
	R: 30 more NJ hospitals receive DRG payments (P, PA)	Pilot medical records database (PA, P)
	R: System expertise builds at organizational level (K)	System expertise builds at governmental level (K)
1983	Payment system adopted for hospitals (P, PA, I)	*R:* DOSTAM system (Grenoble-based) (PA, P)
	HCFA expert committees form (OS)	System expertise builds at governmental level (K)
	System expertise builds at organizational level (K)	
	R: Processes begin to change as diffuse to states (P)	
1984	DRGs, RWs, BP reviewed and amended annually hereafter (P)	Pilot cost accounting and budgeting model (PA, P)
	System expertise builds at governmental level (K)	System expertise builds at governmental level (K)
1985		Uniform hospital discharge dataset (I, PA)
1986		Initial version of GHM classification released (P)
		(transposition and change of American classification system)
		Transposition of American grouper (PA)
		Adopt Fetter's cost modeling system (P)
		System expertise builds at organizational and governmental level (K)
1989		Private, for-profit hospitals required to be part of experiment (I, PA, P)
		Create Medical Information Departments (DIM) in hospitals (OS)
		System expertise builds at organizational level (K)

Table 8.3 (cont.)

Year	United States	France
1991	*R:* DRGs have diffused to 20 states (P, PA, I)	Recording of PMSI data mandatory (I)
		Setting up of DIM mandatory (OS)
		Hospital reform act (legalize DRG system) (P, PA, I)
		System expertise builds at organizational level (K)
1992	Use expands to physician services (P, PA, I)	Creation of a national per-case costs database (I)
	R: DRGs repealed in NJ (P)	System expertise builds at organizational level (K)
1994	*R:* DRGs have diffused to 25 states (P, PA, I)	Mandatory experimentation with all private and public hospitals (P, PA, I)
		PMSI adopted in all public and private not-for-profit hospitals (PA, P, I)
1995		System expertise builds at organizational level (K)
1996		PMSI adopted in all private for-profit hospitals (PA, P, I)
		System expertise builds at organizational level (K)
		R: Juppe reform introduces system of budget adj based on casemix (P)
1997	Use expands to outpt svcs, skilled nursing, long-term care, home health, and rehab svcs (P, PA, I)	Grouping with French GHM released (PA, P)
	R: 18 different PCS in place (P)	Transposition of another American grouper (PA)
1998		Law passed for experimentation of Tarification à la Pathologie (I)
2000		Taskforce created to implement Tarification à la Pathologie (OS)
		National casemix agency created (OS)
2002		Taskforce report (I)
2003		Law commands casemix financing by 2012 (I)
		Payment system adopted (P)
2004		Case mix based financing begins (P, PA, I)
		10th version of GHM classification released (P, PA)
Current	All Patient Refined DRGs in development (P, PA)	

Notes: R = Regional component
I = Information
PA = Physical artifact
P = Process
K = Knowledge
OS = Organizational structure

from the Yale team to design and implement an all-payer DRG system in New Jersey. Eventually, with private counsel and assistance of Jack Owen, the head of the New Jersey Hospital Association, Finley developed a proposal that accommodated the primary interests of key stakeholders, including urban hospitals, who wanted assistance for caring for poor patients; commercial insurers, who wanted relief from cost shifting; state legislators, who desired cost control to address Medicaid cost escalation; and the federal government, who encouraged states to experiment with different forms of reimbursement in order to develop a model for Medicare reform (Mayes, 2006; Chilingerian, 2008). This compromise resulted in the adoption of DRGs in New Jersey as a financial tool in a phased implementation from 1980–82.

In this example, institutional, historical, and political contexts shaped the way influential stakeholders perceived the innovation. Joanne Finley's historical institutional affiliations with Thompson led her to consider the innovation, and the institutional demands of a failing healthcare system encouraged her to look at the innovation as a solution for payment and controlling costs. Jack Owen and Joanne Finley were able to convince other influential stakeholders to accept the innovation as a payment mechanism given the backdrop of political upheaval (threatened lawsuits and escalating costs). Context combined with the *logiques d'action* of influential stakeholders to change the meaning of innovation from a managerial tool to a financial tool – first at the regional level, and then at the national level.

The morphology of innovation

We refer to the process by which components and elements of an innovation change over time as the *morphology of innovation*. It is clear to us that, as PCS diffused to countries and to regions, it changed in breadth, depth, and meaning, and that these changes were driven by the interests and agendas of influential stakeholders, situated in the demands of cultural contexts. While the presence of a set of basic components was similar across cultures, culture shaped the choice of elements within those components and the connections between components. Culture drives the *shape* of innovation – the content and linkages implicit in the object of innovation. In short, *innovations are not culture-free*, as often assumed in the literature; instead, they are infused with cultural values that are embedded as they evolve and change over time in response to the interests and agendas of influential stakeholders. Organizations are the medium through which this process unfolds, and adoption and implementation should not be seen as the end point but rather as one part of the larger process of cultural adaptation.

Specifically, we believe that there are two separate levels at which innovations diffuse – a super-structural (macro) level and an operational (micro) level – and each level corresponds to a different process of adoption and implementation and contributes differently to morphology over time. At the super-structural level, influential stakeholders are concerned about finding solutions to specific problems as they arise over time. For example, in the US case, New Jersey state legislators were concerned about controlling increasing Medicaid costs, and urban hospitals desired relief in caring for poor patients. Over time, after the adoption of DRGs for hospitals, US legislators would be concerned with controlling costs in other settings, such as nursing homes and rehabilitation services. Views about the appropriateness of potential solutions emanate from their agendas and focus on the reproducibility of the innovation in the focal institutional, historical, and political contexts, as well as the comparability of the innovation with other alternatives. In the US, Secretary of Health and Human Services Richard Schweiker headed a committee that evaluated alternatives for financing tools; when they were about to recommend flat rates to Congress, however, he ordered them to develop the DRG approach, having been convinced of the viability of DRGs and assured of the political support of the American Hospital Association through Jack Owen (Chilingerian, 2008). At this level, certain components come to legitimate and define the innovation over time and, thus, we should expect these components to be reproduced more or less similarly among countries. In our case, all countries in our sample adopted some form of information, physical artifacts, processes, knowledge, and organizational arrangements. Within each of these components, certain elements were similar. For example, within physical artifacts, all countries adopted some form of a grouper, a tool that was perceived by stakeholders to be required for the use of PCS.

At the operational level, in contrast, influential stakeholders are concerned with the nuts and bolts of the innovation – functionality, usability, and "making it work" in the local context. This is where stakeholders tailor the innovation to meet local conditions. The Italian experience provides a good illustration of change at the operational level. In 1978, a national health-care system (Servizio Sanitario Nazionale, or SSN), replaced a system of health insurance funds. Before the 1990s, the central government administered payments to regions on the basis of actual expenditures. However, the SSN was reshaped in the 1990s through a process of increasing decentralization from the central government to regional governments, local health authorities (Aziende Sanitarie Locali, or ASLs), and public and private hospitals (Tedeschi, 2008). In this context, each Italian region has developed a distinctive version of organizational and funding models to meet local contextual demands (*ibid.*). PCS is incorporated in these funding models in a variety of different ways across the regions. Some regions use PCS alongside lump sum allocations for specific services (e.g., emergency rooms); other regions use PCS alongside different fee schedules for different types of organizations (e.g., lower fees for rural public hospitals); still others use PCS in conjunction with expenditure targets ceilings or targets or discretional allocations of extraordinary funds; and most use a combination of these (Jommi, Cantu, and Anessi-Pessina, 2001). Emilia-Romangna, Friuli V.G., and Tuscany historically negotiated, additionally, bilateral contracts between local health units (the predecessor to ASLs) alongside PCS (*ibid.*). Further, rates within each PCS vary between regions. Tedeschi (2008) reports that only five regions developed their own regional tariffs, though due to unique provisions in financing models, substantial differences among regional tariffs have appeared through time, ranging from +16 percent to −30 percent of national rates.

At the operational level, one might expect more variation in the elements of innovation as a result of variations in interests and cultural context. Matsuda (2008) notes that the Japanese government feels that it needs to provide objective data for future reforms; thus, one of the main purposes of the PCS project within that country is to collect these data through electronic claim systems that can be used to implement PCS. Therefore, one sees in table 8.2 that information systems to support PCS are relatively more important in Japan than other countries, where data collection is relatively less important to reform efforts. Further variation occurs because, while some elements appear to be similar, they may be used and/or adopted quite differently. For example, it is clear that the Italian payment process, described directly above, and the US and Japanese payment processes, described in the components of PCS section above, are very different; yet, they are all payment processes, an element within the process component of PCS innovation.

In short, culture drives the *shape* of innovation – the content and linkages implicit in the object of innovation. Innovations become infused with cultural values that are embedded in the innovation as it evolves and changes over time in response to the interests and agendas of influential stakeholders. *Culture conditions behavior, which drives demands of the innovation – which changes the innovation itself to conform to demands.* In this way, the innovation becomes "more French" or "more German" or "more Japanese" over time as elements are added, modified, subtracted, or relinked to each other.

Our work on the diffusion of patient classification systems leads us further to posit that there are two dimensions of time in which innovations diffuse – *diffusion time* and *morphological time*. Figure 8.1 shows the diffusion curve for PCS in our sample and illustrates the difference between the two dimensions of time. In particular, Rogers (2003, p. 5) defines diffusion as "the process in which an innovation is communicated through certain channels over time among the members of a social system"; by implication, diffusion time connotes the amount of time it takes for an innovation to be communicated to members of the social system. Diffusion time occurs over the longer

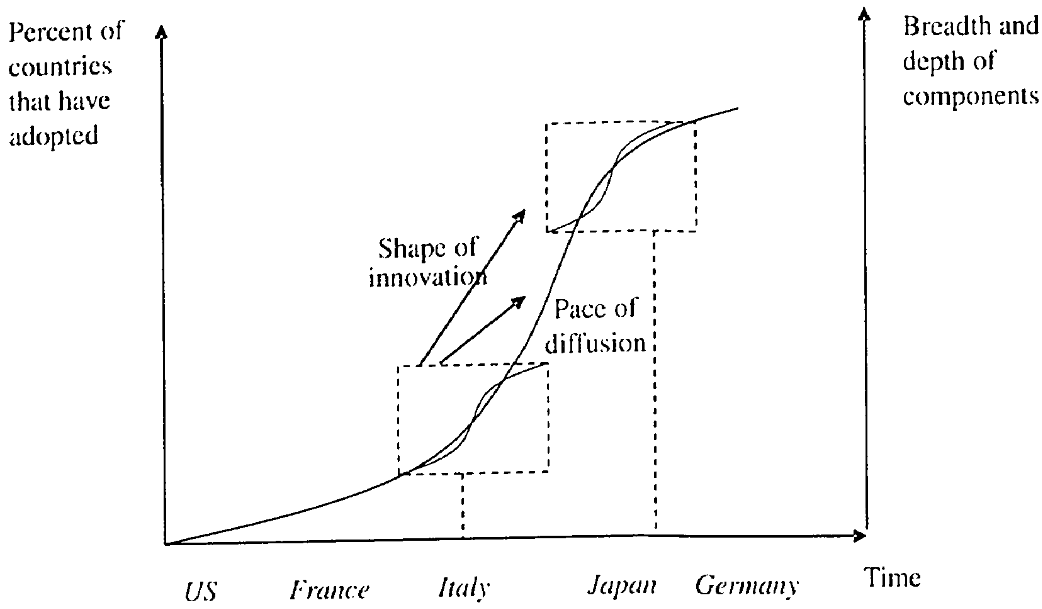

Figure 8.1 Diffusion time and morphological time

s-curve in figure 8.1 and is the dimension of time studied by most innovation researchers. However, we believe there is another dimension of time that is largely ignored in the literature – morphological time. We define morphological time as the amount of time it takes for groups within a social system, individually and in concert, to change an innovation to fit local context, where local can be defined at multiple levels of analysis, such as national, regional, and organizational levels. Morphological time occurs over the shorter s-curves (within boxes at each country's approximate "adoption") located along the aggregate diffusion curve.[7] The first y-axis represents the relevant dependent variable for diffusion time – percentage of countries (adopting units) that have adopted the innovation. The second y-axis represents the relevant dependent variable for morphological time – the breadth and depth of components of innovation present in the adopting unit. One might specify additional dimensions (not shown), such as the percentage of organizations within countries that have adopted the innovation or the breadth and depth of components within particular organizations over time. Note that, while meaning of components is clearly important, meaning cannot be represented on the diffusion curve or on the morphology curve (as meaning is not reducible to one dimension; the traditional diffusion curve implicitly assumes that all innovations are the same); for this chapter, we leave it as implicit in the curve.

According to our data, morphology occurs semi-continuously along the diffusion curve and, importantly, the morphology of an innovation influences the pace of diffusion (i.e., shape of the diffusion curve) and the shape of the innovation as it diffuses (i.e., what is being adopted); both are shown by the arrows in figure 8.1. One can see semi-continuous morphology in table 8.3, where the US and France, two early adopters, are continuing to change their PCSs even today. Further, one can see in table 8.3 how certain events in precedent cases of adoption and implementation shape the design of future adoptions and can speed up the process or slow it down. For example, consultations with the Yale team, who designed the US system, significantly shaped the early adoption and development of PCS in France. The American DRG system and its elements became part of the choice set for France, who picked, chose, and re-worked elements to fit its local circumstances. Outside table 8.3, we know that the pace of German adoption, as well as

[7] We only proxy the shape of morphology curves as s-curves; the lack of previous research on morphology does not allow us to specify the shape with certainty. Data analysis on the shapes of morphology curves for PCS is on our current research agenda.

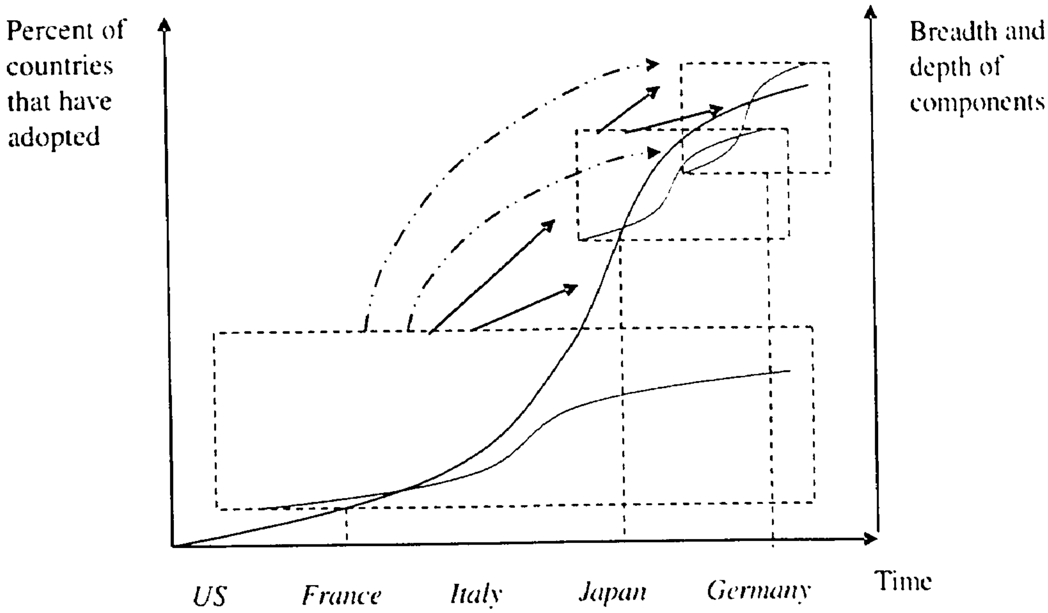

Figure 8.2 Effect of long and short morphological times on future diffusion and morphology

the shape of the innovation ultimately adopted and implemented, was influenced significantly by the existence of other alternatives, and the Germans eventually adopted the Australian system.

Length of morphological time for adopting units influences the pace of diffusion and the shape of the innovation as it diffuses. Specifically, contemporaneous circumstances influence the pace of diffusion and the shape of innovation at any time during diffusion, and sometimes previous adopters change innovation contemporaneously with other subsequent adopters' innovation adoption or morphology decisions. More concretely, figure 8.2 illustrates how long and sometimes short morphology curves can effectively transect processes occurring farther along in diffusion time and, in this way, influence those processes contemporaneously. Though France was an early adopter in the 1980s, its process of adoption of a financing process (an element of the process component) around 2000–2004 should have influenced all contemporaneous adopters, such as Germany, as well as the ongoing morphology of all previous adopters – to varying degrees depending on relationships between countries. This could occur, for example, as it provides another type of financing process to consider, which becomes an element in the choice set for financing processes, or it provides ongoing impetus to potential adopters due to isomorphic pressures to conform (DiMaggio and Powell, 1983). Japan's ongoing morphology should have been a part of the German process, seen in figure 8.1 as an intersection of the Japanese and German morphology curves. Indeed, the data bear out these predictions, though relationships between countries and other factors are mediating variables. For example, the French PCS was among those considered by the German associations commissioned by the German Parliament to choose a PCS, but the Australian version was ultimately chosen, primarily due to the low fees charged by the Australian government (Neubauer, 2008).

Distinguishing between diffusion time and morphological time is conceptually appealing, but raises some thorny methodological problems. The distinction raises the question of whether the same innovation diffuses along the diffusion curve. If the innovation is not the same – if it evolves and changes – then a basic assumption of the diffusion research approach described earlier is called into question. Different versions of innovation may be adopted in different ways (Downs and Mohr, 1976). Also, culture is an unobserved variable in much multinational research. To the extent that culture drives both the shape of innovation (as found in this research) and the correlates of innovation (such as organizational structure, which is often infused with culture; see Kervasdoué and Kimberly, 1979), simultaneity results. Simultaneity tends to produce empirically declining hazard rates and, while problematic in any econometric strategy, it is particularly difficult to ameliorate in survival analysis, the econometric strategy of many diffusion researchers, due to the difficulty of using instrumental variables in this approach (Allison, 1995). Additionally, if previous adoptions drive the pace of current adoptions (in non-isomorphic ways, such as highlighting that there is a solution where there was none before), then we should be including these in our models to get a more complete picture of innovation diffusion processes. In summary, to understand the diffusion process fully, one must understand what is being diffused and why. Both change over time. This is the morphology of innovation.

Connections to other research approaches

The approach we are advocating here, although developed independently, is linked to others in the literature on innovation, particularly those in the tradition of the social construction of technology. The social constructionists argue that human action and economic, political, and other aspects of social context influence the shape of technology at a fundamental level (e.g., Bijker, Hughes, and Pinch, 1987; Bijker, 1995; Latour, 1987; Callon, 1986). Their view challenges technological determinism, or "the belief that technical forces determine social and cultural changes" (Bijker, Hughes, and Pinch, 1987). The technological determinists see the development of technology as proceeding along a predetermined path, largely devoid of cultural influence, and technologies' influence on society as for the most part unidirectional, whereas the social constructionists see social groups as having various interpretations of the meaning of technology, thereby influencing the shape of technological change (Bijker, 1995). Not surprisingly, research on the social construction of technology contrasts sharply with that in the classical diffusion of innovation tradition, with fixed and relatively stable technologies passing in linear fashion from engineer to user in the latter and all relevant social groups participating in the ongoing development of technology in the former (Pollack and Stokes, 1996; Bijker, 1995). While our perspective has much in common with the social constructivists, we identify most closely with research positing that technology is not only interwoven in the conditions of social context, but technologies *in themselves* have social properties (Winner, 1980).

We also see connections with Dosi's (1982) conception of technological paradigms and trajectories. In his view, economic forces, along with social and institutional factors, operate as a selective device on the possibilities for technological development. Once a technological paradigm has begun to develop, however, future improvements have a momentum of their own, and a process of incremental change and problem solving activities follow along a technological trajectory bounded by the selected paradigm, in a fashion analogous to that described by Kuhn (1962) in science (Dosi, 1982). While our viewpoint embraces the concept of a technological paradigm selected by social factors and acknowledges the powerful exclusionary and inclusionary effects of paradigms on future innovation change, it emphasizes the progressive embodiment of social factors in the innovation itself, a process that unfolds both during selection and then as the innovation moves along a technological trajectory.

Finally, a small subset of the adoption and diffusion literature highlights the concept of reinvention. Rice and Rogers (1980, p. 500) define reinvention as "the degree to which an innovation is changed by the adopter in the process of adoption and implementation after its original development." Rogers (2003, p. 188) is on the right track when he contends that: "the general picture that emerges from studies of re-invention is that an innovation is not a fixed entity. Instead, people who use an innovation shape it by giving it meaning as they learn by using the new idea." This literature asserts that most reinvention occurs in the implementation stage of the innovation-decision process, after adoption of a discrete innovation that has already been developed (Rogers, 2003).

Our approach also highlights the importance of change over time in the components of an innovation. However, we emphasize the importance of users as well as history and other aspects of social context, and envisage a more fluid boundary between invention and innovation longitudinally.

Conclusions

By way of conclusion, we would like to reinforce four basic points.

First, the relationship between innovation and culture is more complex than the literature on adoption and diffusion would suggest. Innovations may change as they cross national and regional borders as a function of the interplay of the interests of various stakeholders – users, champions, sellers, and others – and on varying institutional arrangements, historical circumstances, and power distributions. Rather than assuming that innovations are static, researchers should at least allow for the possibility that they change and build this in to their theorizing and their empirics. They should, in other words, use the *morphology of innovation* as a point of departure for their work.

Second, as an area for future theorizing and empirical investigation, it would be useful to begin to develop morphological typologies of innovation. Some innovations, by their nature, may be more susceptible to change than others, and efforts to specify the qualities of innovation that make them more or less susceptible to change as they diffuse would be most welcome. Patient classification systems would, on the surface, appear to be more susceptible to change as they diffuse than, for example, intermittent positive pressure breathing machines, but it would not be wise simply to assume this to be true.

Third, the differences between diffusion time and morphological time should be explored further. Based on our analysis of the diffusion of PCSs, we posited that morphological time unfolds within diffusion time, but we did not address the question of how much an innovation can change and still be the same. We can make the case that PCS as an innovation was basically the same innovation in each of the five countries we examined, and that what we observed was local variation. However, it might well be that some change might be sufficiently frame-breaking to warrant thinking of the result as an innovation in itself, with an entirely new diffusion trajectory. The development of an episode-based as opposed to an encounter-based system in the Netherlands, for example, could be viewed as an extension of PCS logic and hence as a case of morphology in the context of diffusion. However, it might also herald the advent of a radically different approach to resource allocation in health systems and therefore be viewed as a relatively radical departure from what was done previously and hence as an innovation in its own right.

Finally, we believe that a morphological model of innovation computes well with experience. The implicit assumptions of stability and concreteness found in much of the organizational research on adoption and diffusion of innovation may help simplify the job of the researcher, but, when examined carefully, they do not hold up well empirically. Our analysis of the diffusion of patient classification systems in five different countries suggests strongly that national and regional cultures play a significant role in shaping both the form and the pace of innovation and that to ignore this role is to seriously mis-specify the underlying process.

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