Comfortable with a Carcinogen:

The Case of Foam and the Indratech Solution

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Abstract

Polyurethane foam is the world's most popular cushioning product for a wide variety of applications. Although it has many properties that are desirable, there are also serious problems associated with foam's ubiquity. Polyurethane foam is highly flammable, and therefore flame retardants must be added to the material to lessen its potential danger. While these additives do slightly reduce the fire hazard that foam presents, they pose a number of health and environmental problems. Also, polyurethane foam is greatly limited in its potential recyclability.

To address the drawbacks of polyurethane foam while still offering the bulk of foam's desirable properties, Indratech LLC has introduced a polyester-based material known as "Performance Fiber." Performance Fiber meets many of the cushioning standards that could formerly only be met by foam, while also being fire resistant, hypo-allergenic, and highly recyclable. In bringing Performance Fiber to market, Indratech faces challenges outside the normal scope of entrepreneurial competition. Since polyurethane foam is subject to a great deal of regulation, the very same regulations that are intended to limit foam's negative consequences actually work to block Performance Fiber's entrance into the market in some situations, and in effect these regulations can exacerbate those negative consequences.

1. Introduction

Foam is used in virtually any cushioning product. Large market segments include transportation, carpet padding, upholstered furniture, and bedding. The polyurethane foam industry generated over $18 billion in the U.S. furniture market alone during 2005, and there are over 1300 firms involved in the manufacture of foam products. Unknown

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to the bulk of consumers, however, are the hazards that foam presents to individual health and safety, as well as environmental sustainability.

First, polyurethane foam is highly flammable, and has been found to cause and exacerbate many incidents of fire loss. Therefore foam manufacturers use flame retardants and combustion modifiers, also known as polybrominated diphenylethers (PBDEs), which mitigate the flammability to an extent, but introduce a new set of problems. Many PDBEs are known carcinogens and are found in increasing portions in humans, animals, and the environment. There is a particularly large and growing presence of PBDEs in the breast milk of mothers in developed countries, especially in the United States, which is then passed on directly to children in large quantities, and thus accumulates through generations ("bioaccumulates"). Other health concerns involve mold and bacteria associated with foam.

Another key problem with polyurethane foam is its recyclability. Foam cannot be decomposed or recycled like many other materials. For this and other reasons, including economic and wear-oriented factors, there is no foreseeable way to harvest and use foam from consumers as significant input into a foam manufacturing process. New scrap foam arising from secondary fabricating process can be shredded and rebound, but this is only 10-12% of all foam production. Other sustainability issues involve the adverse effects foams have on landfills, and the highly toxic gasses emitted if foam is incinerated.

Indratech, LLC, has recognized the dire need for something better, and has developed a viable alternative called "performance fiber," based on polyester chemistry rather than polyurethane foam. Performance fiber shows excellent flame resistant characteristics and therefore does not require added chemicals. This fiber is hypo-allergenic, among other advantages, thus avoiding many health pitfalls of foam. Performance fiber is also water-resistant and does not produce airborne particles from molds, bacteria, or carcinogens like traditional foam.

Performance fiber is entirely recyclable. Not only does Indratech recycle its own output and scrap for manufacturing, it buys polyester scrap from other organizations to use in its process. Over 10% of Indratech's production comes from recycled polyester and certain blends have up to 50% recycled content.

Indratech began production in 2005 and now the company runs two full-time shifts on three production lines across two locations, and has a number of licensing agreements pending. Indratech has faced significant barriers to entry in this mature industry, where relationships and reputations are long-established, and has attempted to educate potential customers about a product they take for granted and view as a commodity. Indratech has enjoyed significant success, but also faces an often unfriendly industry with powerful opposing interests.

This essay will focus on Indratech's journey to replace foam with a healthier, more eco-friendly alternative and will be organized as follows. Section 2 will address the problems associated with polyurethane foam that have been identified in research literature. Section 3 will discuss the merits of Indratech's performance fiber as an alternative to traditional foam. Section 4 will briefly relate challenges of bringing performance fiber to market, and Section 5 will conclude the paper with policy implications in a context of management literature.

2. Problems with Foam

Polyurethane foam is a highly versatile material and is widely used in seating and sound dampening applications in the transportation industry, and as cushioning for a wide array of furniture, bedding, and carpet applications. It can be molded into specific shapes, or can be used in sheets of a wide variety of thicknesses. Across its many applications, polyurethane foam products can meet resiliency standards over time to be the cushioning product of choice for a virtually unlimited number of applications. Essentially, polyurethane foam bounces back after many uses to maintain its shape as no other material can. Polyurethane foam is lightweight, flexible, and inexpensive. However, there are a number of problems associated with the widespread application of polyurethane foam, three of which are flammability, health issues, and recycling. Following we will address each of these areas.

2.1 Flammability of Foam

A fundamental problem with polyurethane foam is its flammability. Polyurethane foam is highly flammable and is present in many areas of the home – including upholstered furniture and mattresses. In 2002, there were 20,500 fires associated with two polyurethane foam products: upholstered furniture and mattresses. These fires resulted in 840 deaths, 2,110 injuries, and over $521 million in damage (Levenson 2005; Miller 2005). The National Association of State Fire Marshalls (NASFM) refers to foam as "solid gasoline" and describes the situation as follows:

On average, 55 people die per month in fires where upholstered furniture is the first item ignited…The killer is upholstered furniture, which is one of the most flammable items in the American home. In just four minutes, a sofa fire can engulf an entire living room in flames, filling the home with thick, dark smoke and toxic gases. Temperatures can exceed 1,400° F in this short period of time… (*http://www.firemarshals.org/*)

In an attempt to reduce the explosive properties of polyurethane foam, various types of chemicals are added to foam – these chemicals are known as bromated fire retardants, or BFRs. The incidence of foam-related fires are trending downward in recent years (Miller 2005; Levenson 2005), and fire retardants have been found to be a key contributor to lowering the incidence of such fires, and are said to have "reduced the economic costs of fires" (Birnbaum & Staskal 2004). Over seventy thousand tons of fire retardants are sold annually in the U.S. market (Hites 2004), and, in 2003, the U.S. market was over $1 billion and growing at a 4% clip (Lunder & Sharp 2003). Polybrominated diphenyl ethers (PBDEs) are the fundamental ingredient of these fire retardants, and it is these PBDEs that are central to many health and environmental concerns.

2.2 Health Issues Associated with Foam

The structure of PBDEs has been found to be similar to that of PCBs and DDT "in terms of inducing genetic recombination, which causes a number of diseases including cancer." (Rahman et al 2001, p.11) Beyond its potentially carcinogenic properties, PBDEs have been linked to hormone imbalances, adverse effects on the immune system, and problems with childhood organ development (Rahman et al 2001; Lunder & Sharp 2003). Emissions from heated or burned PBDEs are also thought to be carcinogenic, and may lead to birth defects and chloro-acne (Lunder & Sharp 2003).

While possible health hazards associated with PBDEs are many, these hazards are not equal across all forms of PBDEs. It is important to note, however, that even the least toxic PBDE (the "deca" product), has been deemed by the U.S. Environmental Protection Agency to be a "possible human carcinogen," based on "suggestive evidence of carcinogenicity" (Hites et al 2005). In support of this conclusion there is (as of yet) a very limited amount of research associated with the deca-product, so nothing conclusive can be said (Hites et al 2005). With other forms of PBDEs – the "penta" and "octa" products – adverse health effects have been documented and they are being phased-out of production in Europe and the United States.

Even if production and consumption were stopped today, PBDE levels in humans would continue to increase due to bioaccumulation (Rahman et al 2001). The greatest single exposure of humans to PBDEs in their lifetime is through their mother's breast milk – which contains concentrated levels of PBDEs - during infancy (Jones-Otazo et al 2005). The next major pathways for PBDEs in humans are inhalation of house dust and ingestion of animal products (Jones-Otazo et al 2005). Absorption of PBDEs also occurs through inhalation of particles emitted from foam processing or the foam itself, and direct skin contact with flame-retardant product (Hites 2004; Watanabe & Sakai 2003).

PBDEs "have become ubiquitous in the environment and in people" (Hites 2004, p.945). The amount of PBDEs in humans, animals, and the environment has increased exponentially in the last 30 years, and is doubling every four to six years (Hites 2004). High quantities of PBDEs have been found in the tissues of a wide variety of animals, including whales, seals, birds, bird eggs, moose, reindeer, mussels, eels, and multiple species of fish (Lunder & Sharp 2003). PDBEs are also found throughout the physical world, for example, sediment samples from rivers, dust in offices, and airborne in manufacturing plants (Rahman et al 2001). While PBDEs are released into the environment during manufacturing and use, they are also released through disposal. Next we will discuss issues associated with the disposal of polyurethane foam.

2.3 Recycling Foam

Polyurethane foam is disposed of in three different ways: through landfills, incineration, or recycling. Each of these disposal methods has its own significant drawbacks. The bulk of polyurethane foam is disposed of in landfills (Zevenhoven 2004). Polyurethane foams do not degrade without the help of chemical reactions, and therefore will persist over time. Beyond issues associated with non-renewal, polyurethane foams presence in landfills is not entirely benign, as certain forms of fire retardants are superficially bound to the polyurethane and can bleed over time into the environment (Rahman et al 2001).

An alternative to landfills is incineration. This option is highly problematic as incineration of polyurethane foam results in the release of chlorofluorocarbons (CFCs – which are primarily responsible for ozone depletion) as well as other "blowing agents" (Zevenhoven 2004). According to the Polyurethane Foam Association, polyurethane foam "Like any other organic material, when it ignites and burns, [polyurethane foam] liberates smoke containing toxic gases, the primary one being carbon monoxide." (http://www.pfa.org) As neither landfills nor incineration is ideal, the preferred disposal method would be to recycle foam, however, foam recycling is not unproblematic.

There are four primary ways to recycle polyurethane foam: regrinding, powdering, adhesive pressuring, and chemical recycling (Zevenhoven 2004). Regrinding foam has traditionally been prohibitively expensive, as the processes are capitally intensive, yet only up to 10% of certain new products (such as carpet padding) can be made from reground foam. Powdering is more promising, which grinds foam into small particles that can be used for injection molding applications. Some injection molded parts can utilize up to 50% recycled foam material. Again, the shredding process in both of these applications can be quite expensive. This is in part due to the release of fluorocarbon compounds during the shredding process that must be captured. The other methods – adhesive pressuring and chemical recycling – are still quite new, have highly limited applications, are rarely employed, capitally intensive, and rife with their own limitations (Zevenhoven 2004).

Most polyurethane foam recycling processes are open-loop, where the scrap from one product becomes the raw material of another. Closed-loop processing is generally not considered possible although recent options do exist for polyurethane foam scrap to be used as an input. In such an application, the maximum input of recycled material is 7% of the overall foam weight (Andreolli et al 2003).

In this section we indicated three broad issues associated with polyurethane foam: (1) it is highly flammable; (2) the flame retardants used are associated with health and environmental concerns; and (3) recycling options are expensive and limited. This is not an exhaustive list of issues with polyurethane foam, but they are the primary ones. Next we will introduce a new alternative to polyurethane foams for many applications that addresses each of these issues. This alternative material is known as "Performance Fiber."

3. The Performance Fiber Alternative

To date there has been no realistic alternative to polyurethane foam for a great number of cushioning applications. This is largely due to the unique ability of foam to be compressed under a variety of conditions and "bounce back" consistently over time. Fiber products made of other materials have been proven to have similar properties to foam, but do not exhibit the resiliency of foam – especially when the application requires thick cushioning. Indratech, LLC, of Auburn Hills, Michigan, has devised a manufacturing process for fiber which is based on innovative materials that enable more eco-friendly plastics to be used for a cushioning product that rivals foam in its desirable qualities, but avoids all of the major problems associated with foam. Indratech refers to this alternative cushioning product as "Performance Fiber."

Performance Fiber is made up of polyester, as opposed to the polyurethane which comprises traditional foam. Historically polyester fiber was not a viable alternative to foam for many cushioning applications because it did not maintain its form when compressed, especially for thicker applications. Indratech employs an innovative "elastomeric binder" that enables fiber to bounce back – offering cushioning properties that rival traditional foam at roughly the same price point. Also, polyester offers a number of advantages to polyurethane:

> *The most common polyester for fiber purposes is polyethylene terephthalate or simply PET. This is also the polymer used for many soft drink bottles and it is becoming increasingly popular to recycle after use by remelting and extruding as fiber… Polyester is strong, has good resistance to stretching and shrinking, is resistant to most chemicals, drying quickly, remains crisp and resilient when wet*

or dry. It is mildew resistant, abrasion resistant, retains heat set and easy washable. (Khambete & Suzuki 2005)

While Performance Fiber offers these advantages over polyurethane foam, it also is able to address the problems associated with polyurethane foam. For example, Performance Fiber is far more fire resistant than polyurethane foam, therefore does not require fire retardants. Also, as polyester is a highly recyclable polymer, Performance Fiber lends itself quite well to a high degree of recycled content as well as both an input and an output of either open or closed loops processing. Next we will briefly offer more detail about how Performance Fiber addresses the traditional limitation of fiber technology – the ability to "bounce back." Then we will discuss how Performance Fiber addresses each of the three primary concerns associated with polyester foam.

3.1. "Bouncing Back"

There are two primary attributes associated with the resiliency of a cushioning product. The first involves the ability of a cushioning product to maintain its form after compression – this is measured through various "height loss" tests. The second involves the ability of a cushioning product to maintain its ability to cushion, given repeated compression over time – this is measured through "indentation load deflection" (ILD) tests. Following we will compare polyurethane foam and polyester fiber in these two broad areas.

There are a number of height loss tests that are specified by governmental and industry organizations. These tests generally involve compressing foam or fiber cushions from as little as 10% of original height to as much as 90% across a variety of temperatures. In the past, polyester fiber has generally failed these compression tests, as the height of the compressed foam would rebound only partially. With the elastomeric binder technology of Performance Fiber, however, fiber can rival foam in many height loss tests. For example, in tests of height loss with compression up to 25% and 50 degrees Celcius (122 degrees Fahrenheit), Performance Fiber "performs handsomely" with failures under 7% (Khambete 2006b). While foam still enjoys superior height loss test performance, Performance Fiber posts strong numbers are acceptable for many applications.

Table 1: Performance Fiber Height Loss Test Results
(Source: Indratech, LLC)

Product	**Pass Criteria**	**Indratech fiber Performance**
Prison Mattress Test: ASTM F1566-99 Part 7 (100,000 Hexagonal Roller test)	Current competition: traditional polyester fiber Height loss up to 60%	4-7% height loss
Office Furniture ASTM D3574-03 Test I3 Procedure B (80,000 cycles constant force pounding)	Current competition: polyurethane Foam 8 - 13% height loss	9 – 15% height loss
Transport (bus) ASTM 3574-8 (180,000 cycles)	Current competion: polyurethane foam 3-7% height loss	7-14 % height loss

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Performance Fiber significantly outperforms foam in indentation load deflection tests, which measure the cushioning product's ability to remain firm and is the primary measure of comfort. For example, one ILD test (known as the "butt test") uses the imprint of a human bottom to measure the force required to compress the product 25% of its original height, then measure the force required to compress the product 65% of its original height. This is repeated tens of thousands of times and the resulting score is a function of these two measures, and this score changes over time as the cushioning ability of the product is reduced. Over time, Performance Fiber will lose roughly 5-9% ILD in such a test, whereas foam will typically lose 25-30% ILD – essentially "breaking down" (Khambete 2006).

Surendra Khambete, the president of Indratech, describes how polyurethane foam acts given limited height loss with a great deal of cushioning loss:

> *When you first sit on it, it should be soft, then it should be firm. So these ILDs – the force required for that 25% and that 65% is the actual force required. And what happens is when you pound foam one hundred thousand times, the force required to compress it 25% is much lower now because it's just collapsed, the cells have just collapsed. So it feels cheap because you can go to 65% or all the way down with no force at all. But it rebounds back to 100% [of its height]. Where [Performance Fiber] with eighty thousand cycles will lose 10% of its height, but it feels more like when it was new. (Khambete 2006b)*

Therefore the fundamental tradeoff in performance associated with Performance Fiber is a small degree of height loss in return for a superior cushioning product over time.[1] In addition to this, Performance Fiber addresses the three major concerns associated with polyurethane foam: flammability, health issues, and recyclability, which we will now address.

3.2. Addressing the Problems with Foam

Performance Fiber, while performing well in cushioning applications, greatly surpasses polyurethane foam in three critical areas: flammability, health issues, and recyclability.

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[1] This is not an unproblematic tradeoff, as height loss is important to a number of applications where maintenance of original form is critically important.

First, in many flammability tests, polyester fiber generally melts and has actually been found to self-extinguish under certain applications (Khambete 2006a). Table one indicates the flammability characteristics of Performance Fiber given many popular tests. The "Criteria" column indicates the minimum standards for polyurethane foam – and polyurethane foam cannot meet these standards without the addition of flame retardants (PDBEs). Polyurethane foam products will just barely meet these requirements. The "Results" column unequivocally shows how Performance Fiber not only meets the flammability requirements, but dramatically outperforms foam – in one case by a ratio of 100:1.

Table 1: Performance Fiber Flammability Test
(Source: Khambete & Suzuki 2005)

Test Standard	Criteria	Result
ASTM D 3675	Flame Spread	
Flame Spread Index	<= 25	7.9
ASTM E 662	Smoke Density	
Flamming 90 Seconds	100 Maximum	32
4 mintues	200 Maximum	34
Non Flamming 90 Seconds	100 Maximum	1
4 mintues	200 Maximum	3
FAR Part 25 Appendix F		
Part 1 12 Second Vertical Burn Test		
After Flame Time	<= 8 inches	2
Average Burn Length	5 seconds	1

Because these flammability measures involve polyester fiber without flame-retardant additives, all concerns associated with PBDEs in humans, animals, and the environment are not exacerbated by manufacturing Performance Fiber. The polyester used in Performance Fiber is hypo-allergenic (Khambete 2006a).

Finally, polyester as a material is highly recyclable. Recycled performance fiber can be used to make more performance fiber simply by shredding the fiber in a closed-loop process (up to 50% recycled content). Also Performance Fiber can be recycled into the types of polyester used to make soft drink bottles and other products based on certain forms of polyester. In addition, soft drink bottles and similar products can be used to make the raw materials for input in Performance Fiber. Indratech's plants have no scrap from their manufacturing processes, as all scrap becomes input into the next batch of performance fiber. Also, currently Indratech purchases recycled polyester as an important input into its process (Khambete 2006a).

4. Challenges Bringing Performance Fiber to Market

Indratech faces a number of challenges bringing Performance Fiber to market. Many of these challenges are similar to that of any entrepreneurial organization that has relatively limited resources, history, and legitimacy, and must educate customers and prove themselves in ways that established firms need not. However, Indratech also faces some deeply entrenched institutions and their associated forces that are fundamentally blocking Performance Fiber's access to legitimacy while promoting the status-quo of polyurethane foam domination. Specifically, a number of standards organizations exist to regulate the foam industry, and this regulation body is heavily influenced by the foam industry, as the regulations are written to the capabilities of polyurethane foam. Since Performance Fiber is attempting to displace foam in many applications, Performance Fiber becomes subject to many standards that do not necessarily apply. Following we will address two examples of such regulation that tangibly, and arguably unreasonably, restrict Performance Fiber's access to applications where it might benefit consumers and the environment to the detriment of the powerful polyurethane foam industry. The first addresses a specific flammability regulation, and the second, a specification for compression testing.

4.1. Flammability Example

The first example involves flammability. There is a wide array of specifications governing foam flammability. One such specification is TB-129[2], which a federal mandate governing the amount of "mass loss" is allowed if a mattress were to burn. Khambete (2006b) describes the situation associated with mass loss regulation:

> *For flammability, normally most people are concerned with toxicity of gas, heat dissipation, and heat propogation. How much heat is generated in the room?… How fast does it propogate over the surface? And then what is the toxicity of the smoke? Etc. A certain test [TB-129] specifies no more than 3 pounds or 20% of mass loss, which is weight loss, or the product fails the test. Now ironically polyester doesn't burn as easily as foam, it doesn't emit toxic smoke as foam, its flame does not propogate as fast as foam, and it does not create as much heat, but it melts. And because of that mass loss, almost always we fail. And that has really nothing to do with safety… and I have written letters to the ASPC saying "can you explain why mass loss is a criteria for flammability?" … Now certain applications might say now this is the reason, but I haven't quite found it… even the melted droppings which fall on the human body would just give superficial burns.*

According to the Bureau of Home Furnishings and Thermal Insulation, this specification was intended to "prevent a mattress from causing a major flashover fire," (BHFTI 2000)

[2] TB-129 is shorthand for the Bureau of Home Furnishings and Thermal Insulation Technical Bulletin #129, which has been adopted by the American Society of Testing and Materials (ASTM) as ASTM E-1590; and by the National Fire Protection Association as NFPA 267.

ostensibly by the embers dislodging from the main product and being carried off to start such "flashover" fires. The mass lost acts as a proxy for flaming materials carried off. As Khambete indicates above, this standard does not address the issues associated with polyester fiber, and therefore the standard disadvantages what is in actuality a superior product in regards to flammability and in limiting "flashover" fires.

4.2. Compression Example

ASTM-3574 is a set of testing standards for polyurethane foam set by the American Society of Testing and Materials, and among these testing standards are "compression set tests" intended to measure the height loss of a foam product under various levels of compression at different temperatures. One such test involves compressing a seat 90% of its original height for 22 hours at 70 degrees Celcius (158 degrees Fahrenheit). Khambete (2006b) describes the results of this test and its implications for Performance Fiber:

> *At that point our product fails because it almost molds it. It loses about 25% of its height while foam comes all the way back up to within 2% of its height. And what we tell the customer is "I am not sure which human being will sit or sleep for 22 hours in a row at 158 degrees Fahrenheit."… I only know that 70 degrees C is the glass transition temperature of polyester. It softens at that temperature. … What we can do is raise the temperature to 70 degrees C, which typically might happen in with automotive or in RV [applications] in the desert… typically we would say it happens for four, or five, or six hours. And if you realistically put a briefcase or a suitcase like you're going to the airport on the seat, it doesn't compress it 90%. It compresses it maybe 10%, 12% of the initial height. That we have fairly good performance – it bounces all of the way back or we fail about 5% which is typically considered within spec. So I almost*

> *always have to reeducate, or educate the customer saying "even if you are going to the airport and you have a 40 pound bag laying on the seat overnight," you are looking at about four hours of compression at about 10%, and we've got some data. We come back to about 7% of original height. Which is acceptable.… Right up front some people say "You're going to fail the compression test," and we say "We might as well walk out right now, because if that's the criteria, this material is not going to pass it."*

Khambete indicates that this test is common practice, and again, he cannot understand any practical reason for its application to Performance Fiber. Rather, the coincidence of 70 degrees Celcius as the glass transition point of polyester indicates that it may be a defensive move on the part of foam manufacturers to ward off forays into their market by polyester fiber producers. While, until Performance Fiber, no polyester fiber product has been able to compete in horizontal seating – the promise of eventual competition from polyester has been around for many years (Khambete 2006b).

These two examples show how standard tests which are used for regulation and specification of polyurethane foam can be used to exclude competition from innovative materials that meet performance specifications, but fall short on particular highly contextualized situations. The first test, that of mass loss and flammability, describes a situation where tests were written specifically for foam in order to improve safety, but inadvertently excludes the safer alternative of Performance Fiber. The second test, that of height loss at 70 degrees Celsius, can be interpreted as an attempt of the powerful foam industry to use regulation to protect the applications of their product (if one looks at the temperature selection as not merely a coincidence) from outside competition – to the potential detriment of individuals, society, and the environment.

5. Discussion & Conclusions

This essay has introduced an alternative to polyurethane foam, which is known as "Performance Fiber." Polyurethane foam is ubiquitous with virtually unlimited applications. However, this popular foam product comes with a number of safety, health, and environmental risks. Specifically, it is dangerously flammable, and toxic, carcinogenic additives (PDBEs) are added in order to mitigate this flammability. These chemicals are released into humans, animals, and the environment throughout the manufacturing, use, and disposal of polyurethane foam. Also, polyurethane foam recycling is highly problematic, inefficient, and greatly limited in its potential.

Polyester-based Performance Fiber is a new alternative to foam, which is an improvement for a wide variety of applications to polyurethane foam. It performs better than foam in many tests, is lighter, significantly less flammable, highly recyclable, and hypo-allergenic. However, Performance Fiber is barred from many applications due to the established regulations intended to govern polyurethane foam as a material. Some of these specifications do not apply to Performance Fiber, and may have been intentionally put in place to keep polyester fiber from cushioning applications. In such cases, regulation actually makes the situation worse (the situation that it was ostensibly intended to improve) by excluding a qualitatively superior solution – for both the application as well as society in general.

Management literature has a rich tradition of illustrating how incumbent firms become tied to their traditional ways of doing business, and eventually fall prey to innovative firms that outmaneuver them. This dynamic has been described as “creative destruction,” (Schumpeter 1942), the “productivity dilemma” (Abernathy 1978), and more recently, the “innovator’s dilemma” (Christensen 1997). In order to avoid this, most prescriptions for existing firms center on finding ways to innovate and stay ahead (Lazonick 1991; March 1991). As incumbent firms are constantly innovating, the knowledge of this will keep organizations innovative and efficient – essentially the market “disciplines before it attacks” (Schumpeter 1942, p.85). This market activity, however, generally assumes no regulation propping up the incumbent firm.

Governmental regulation, while defending public goods and the interests of individuals, may inadvertently act to prop up incumbent firms in the face of disruptive competition. By propping up the incumbent firm, the regulations may, in fact, exacerbate the problems they are intended to solve. The specifications illustrated in the previous section offer tangible examples of this phenomenon. These examples show how a societally superior product can be kept from certain applications based on factors beyond the normal competitive market forces. The challenges associated with regulation of existing products are made even more problematic when regulatory bodies must consider existing products in light of promising alternatives.

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7. About the Author

Nick is the former president of Pentagon Engineering Corporation, a nationwide systems integration firm that specialized in product development processes. He co-founded the company in 1995 and managed it until its sale in 2002.

Nick has an MBA with a concentration in information systems from Case Western Reserve University. He is now a doctoral candidate at the Case's Weatherhead School of Management and is the instructor for MIDS 327/427 (Database Management). Nick's current research projects are focused on processes, including the relationship between enterprise information systems and business processes, and the role of information systems in product development and system design processes.