Tech Material Use Cases and Applications

Confidential

Robert Hale & Associates

BUILDING BRAND AND MARKET SHARE

Objectives

- The objectives of this engagement are:
  - Identify key applications for Client X (with a strong focus outside of sporting goods)
  - Identify top applications by market size and other criteria (after interim)
  - Determine key contacts and tactics that will be useful to Client X (after interim)

Purpose of Interim

- Discuss Key Applications to Pursue
- After Interim
  - Estimate Market Size
  - Identify Top 10 Applications
  - Identify key players to approach (and other associated information

Methodology

- We have conducted extensive primary and secondary research
  - Approximately 35 interviews in the following applications:
    - Transportation (auto, air, marine, rail, etc.)
    - Manufacturing
    - Highway Safety
    - Sporting goods
    - Medical/Healthcare
    - Construction
    - Law Enforcement/First Responders
    - Consumer Electronics
    - Packaging
    - Alternative Fuels
  - See following slides for specific

Primary Research Sources - Contacted

Name - Phone	Organization	Expertise	Category
Todd Pierce– 202-366-5291	National Highway Transportation Safety Board	Automotive safety applications	Government / Commercial
Quanxi Jia - 505-667-2716	Los Alamos National Laboratory	Protective Clothing (fiber yarns)	Government
Jaho Yushene – 505-667-3886	Los Alamos National Laboratory	Nanotechnology in high pressure applications	Government
Bradley Hughes - 951-956-8468	University of California – Riverside	DNA Processing - electrophoresis	Academic
Dale Campter - 513-533-8457	National Institute for Occupational Safety and Health	Motorcycle safety applications	Government
Eric Lin - 301-975-6743	National Institute for Standards and Technology	Automotive, sporting goods, soft body armor	Government
Joyce Waters - 301- 975-8001	National Institute for Standards and Technology	General Nanotechnology	Government
Lloyd J. Whitman - 301-975-8002	National Institute for Standards and Technology	General Nanotechnology	Government
Hongda Chen - 202-401-6497	USDA	Food Processing	Government
Jeff Urban - 510-486-4526	University of California – Berkeley	Automotive, drilling, reverse osmosis, packing materials	Academic
Jonghwan Suhr – 775-682-7481	Rensselaer Polytechnic Institute	Aerospace	Academic
Les Makepeace - 303-659-9148	Colorado Nanotechnology Alliance	Maritime, aerospace, sporting goods	Trade Organization / Commercial
Louis J. Terminello - 925-423-7956	Lawrence Livermore National University	Bomb boxes, aerospace, firearms, sporting goods	Academic
Jon Barry – 202-366-1875	US Dept. of Transportation – Maritime Division	Maritime	Government
Curt Smith- 202-267-8166	Federal Aviation Administration – Aircraft certification	Aerospace	Government

Primary Research Sources – Continued

Name - Phone	Organization	Expertise	Category
Peter J F Harris - +44 118 378 6118	University of Reading (UK)	Protective clothing and Nanotubes	Academic
Nikhilesh Chawla – 480-965-2402	Arizona State university	Sporting goods	Academic
Griffith A. Kundahl – 303-871-7409	University of Denver	General Nanotechnology	Academic
Michelle Iafrat – 480-727-8190	Center for Nanotechnology in Society	General Nanotechnology	Trade Organization
Doug Giese – 858-692-2128	Client X	AgileZorb	Commercial
Yu Qiao – 858-534-3388	Client X	AgileZorb	Academic/Commercial
Wayne Patterson - 541 459 4326	Client X	Sport Goods	Commercial
Monique Stewart – 202-689-4313	Federal Highway Administration	Nanotechnology	Government
Peter Eun - 202-493-3371	Federal Highway Department	Highway Safety	Government
Ray Cramis - 202-493-3312	Federal Highway Department	Highway Safety	Government
Shennian Luo - 505-665-8554	Los Alamos National Laboratory	Nanotechnology in high pressure applications	Government
Nadya Lumelsky, Ph.D. – 301-594-7703	National Institute of Health	Nanotechnology in dental applications	Government
Dr. Pancrazio – 301-496-14447	NINDS	Prosthesis	Government
Ray Chambis - 202-493-3312	Director of R&D, Department of Highway	Highway Protection	Government
Prabhakar R. Bandaru – 858-534-5325	University of California – San Diego	Nanotubes in compression applications	Academic

Major Secondary Research Sources

- AJ Manufacturing Company (shock and vibration product list and specifications)
- Bioinspired Nanocomposites for Orthopedic Applications, Huinan Liu and Thomas J. Webster, 2005
- Prism Webcast News, “Scientists use nanoscale catalysts to produce biofuels from syngas”, August 18, 2008
- “Challenging times for European Plastic Pipe System suppliers”, Plastemart, January, 2009
- “Plastic Pipe – Changed Face of Underground Infrastructure”, Underground Construction Magazine, September, 2005
- “Nano-Proprietary, Inc. Achieves Flexural and Compression Strength Improvements in Epoxy/Carbon Nanotube Composites”, Reuters, June 17, 2008
- “Electron and phonon renormalization near charged defects in carbon nanotube”, Apparao M. Rao, October, 2008
- “Rational Synthesis of Helically Coiled Carbon Nanowires and Nanotubes through the Use of Tin and Indium Catalysts”, Advanced Materials, 2008
- National Nanotechnology Initiative, Supplement to President’s 2009 FI Budget
- “A Look Into the Future of the U.S. Medical Device Market”, Medical Device Link, January 2009
- “Diagnosis: Medical Device Industry Looks Healthy”, Industrial Market Trends, David Butcher, March 27, 2007
- D Marinac-Dabic, “CDRH Post-Market Transformation: Challenges and Opportunities in Improving Medical Device Data Sources,” in Proceedings of The National Committee on Medical Device Registries, (Philadelphia: Biomedical Research and Education Foundation, June 21, 2006), 4–6.
- US Navy Maritime Standards Office (Researching shock-absorption standards)
- US Patent & Trademark Office
  - Pending and Issued patents
- TradeKey Sourcing
  - Plastic honeycomb and honeycomb sheet vendors and specifications

Use Case Assessment Overview

Sample Use Cases by Category

Application	Description	PSI (Range)	Loading Rate	Solution Currently Adequate	Other
Road Maintenance					
-Trees and poles	Currently DOT is looking at alternatives	100+	High	No	Currently not a good solution. "Excellent opportunity" (<$100)
-Crash barriers	Barrels, reinforced concrete	300+	High	Yes, except for array of crash cushions (fewer barrels)	Could possibly work in this ("certain applications where there is less space")
Automotive					
-Bumpers	Accident collision dampening (reinforcing)	300+	High	Yes	Possibly good fit if cheaper/lighter than aluminum honeycomb
-Motorcycle	Helmets	Unknown	Med-High	Depends	*"This technology you are talking about would be good in motorcycle helmets."*
Aerospace					
-Vibration insulators (within fuselage)	Unmanned aircraft, possibly commercial, satellites	Unknown	High	No	Looking for lighter, more compact solution
Maritime					
-Ship electronics		Depends	Depends	Larger Ships are an issue	Large vessels may need additional protection
-Seat suspension for watercraft	Water craft experience strong shock waves, and some can cause injury	Unknown	Med-High	Depends	Increases safety of usage

Sample Use Cases by Category

Application	Description	PSI (Range)	Loading Rate	Solution Currently Adequate	Other
Law Enforcement					
-Body armor		High	High	Yes, but still has pain from compression	A good fit, but law enforcement does not have budget
-Bomb boxes		Very High	High	Too bulky and sometimes won't work	Improvement in current application. Would be part of budgets for Terrorism.
Healthcare					
-Medical footwear	Diabetic, medical, posture, elderly	50-300	Med-High	Depends	Need more understanding
-Prosthetic feet		Unknown	Med-High	Some	Not a good solution per interviews
Firearms/Hunting					
-Recoil	Firearms, flare launcher	60+	Med	Depends on weapon	Several interviewees indicated good solution
Rail Car					
-Railroad passenger cars interior padding	Protection from sudden/abrupt stops	50+	Med-High	Looking for solution (current research)	Application is appropriate and budget is available

Sample Use Cases by Category

Application	Description	PSI (Range)	Loading Rate	Solution Currently Adequate	Other
Sporting Goods					
-Vests	Paintball	5+	High	Yes	Few injuries
-Gloves	Baseball	Unknown	Med-High	Yes	Inflatable bladders for baseball gloves exist since 1992
-Catcher's chest protector	Baseball	Unknown	Unknown	Not good solution for kids	Unsure if parents are willing to pay more
-Grips, gloves	Bicycle, motocross, other sports	Moderate	Low	Most of time	
-Helmets	Hockey, Lacrosse, Football, Equestrian, roller sports, skiing/snowboard, bicycle, skateboard, baseball	5-10	Med-High	No – high value	
-Shoe insoles (or layer)	Running shoes (non-competitive) or basketball (in heel)	50-300	Med-High	No, because of space	
-Pads	Hockey, Soccer, Football, bicycle, skateboard	Mod-high	Low-Med	Yes, for most issues	
-Clothing	Various sports where gel padding is currently used	Depends	Depends	Yes, with some exceptions	

Sample Use Cases by Category

Application	Description	PSI (Range)	Loading Rate	Solution Currently Adequate	Other
Ambulance					
-Electronics shock protection	Protect electronics from impacts	Depends	Depends	Yes	
Aerospace					
-External and Internal use for lighter					See Key Findings
-Flight data recorder (black box)		Very High	High	Yes	
Consumer Electronics					
-Protective casings	Protection against dropping/impacts	Depends	Low-Mod	Yes	
Construction					
-Pile driver pads (pile cushion)	Cushion placed between drive cap and top of concrete pile to protect pile from crushing and sprawling	Depends	Depends	Yes	Useful to extend life of pile driver pad (but current solution works)
-Sound absorbing material	Replacement for soundboard or other sound dampening	Depends	Low	Yes	Very few applications where Client X would be a better fit
-Jack Hammer or other high vibration equipment	Grips & gloves	10+	Med-high	No	Difficult to hold on to machinery for long periods of time
-Building foundations	Reinforcement for commercial building foundations to protect against seismic activity	Depends	Low	Yes	May be too costly to replace springs or current solution
Infrastructure					
-Underground pipe	Water, natural gas, etc.	Depends	Mod	Yes	PVC joints

Sample Use Cases by Category

Application	Description	PSI (Range)	Loading Rate for Compression	Solution Currently Adequate	Other
Drilling					
-Drilling cables		Depends	Mod	Yes	Doubtful application
Biofuels					
-Bio distillation	Piston-like action to distill biofuels based on oscillatory action	Depends	Mod	Yes	Unlikely
Packaging					
-Protection for shipping high value items		Depends	Mod	Yes for nearly all applications	Styrofoam peanuts currently appear to be adequate (and very cheap) for most applications

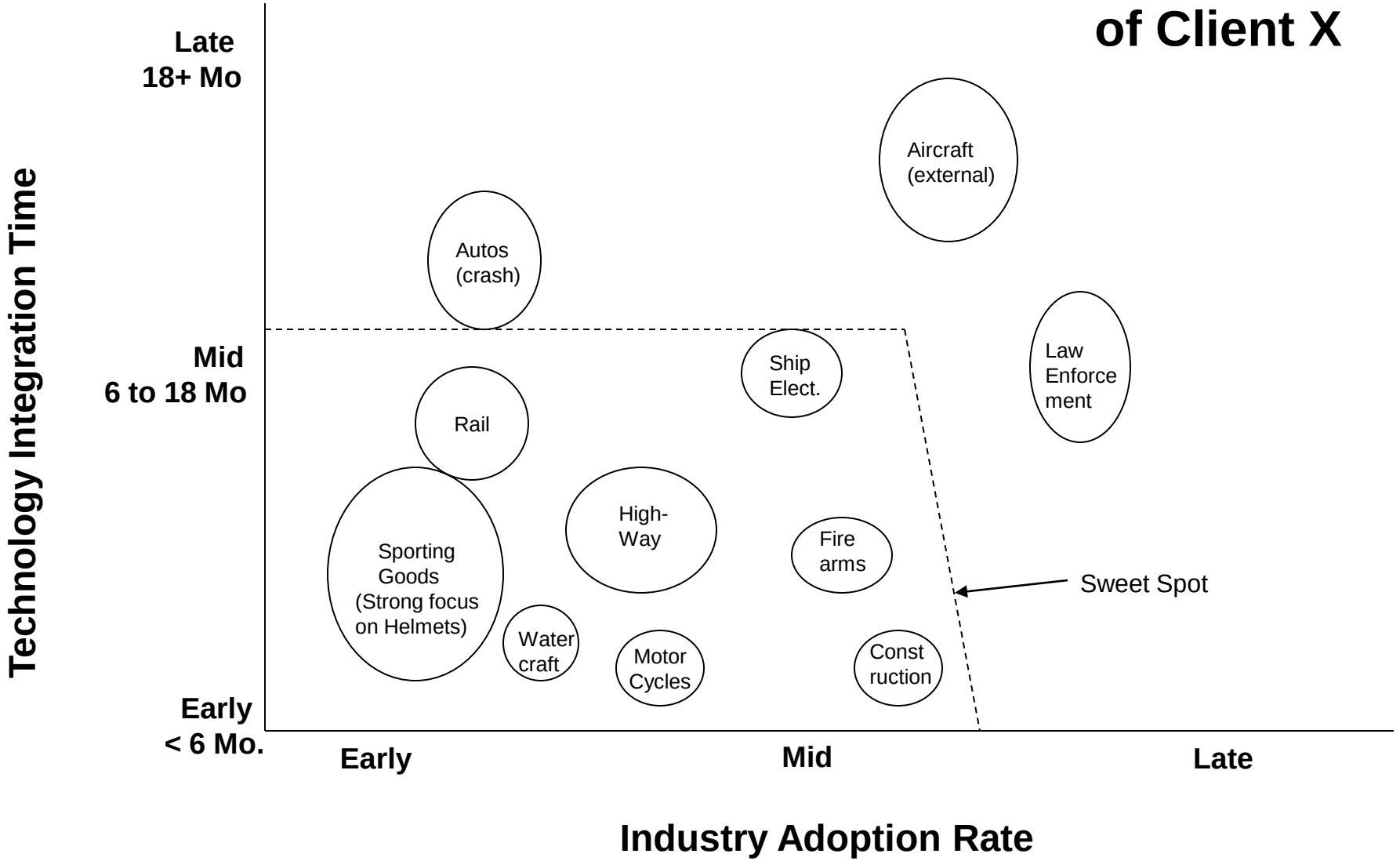
Sporting is a Good Application

Basketball, Bicycle and Football are big sports for Shoes and Helmets (other than running)

Estimated Number of Injuries	Sport and Type of Injury
529,837	**Basketball** - Cut hands, sprained ankles, broken legs, eye and forehead injuries.
490,434	**Bicycling** - Feet caught in spokes, head injuries from falls, slipping while carrying bicycles, collisions with cars.
460,210	**Football** - Fractured wrists, chipped teeth, neck strains, head lacerations, dislocated hips and jammed fingers.
275,123	**ATVs, Mopeds, Minibikes** - Riders of ATVs were frequently injured when they were thrown from vehicles. There were also fractured wrists, dislocated hands, shoulder sprains, head cuts and lumbar strains.
274,867	**Baseball, Softball** - Head injuries from bats and balls. Ankle injuries from running bases or sliding into them.
269,249	**Exercise, Exercise Equipment** - Twisted ankles and cut chins from tripping on treadmills. Head injuries from falling backward from exercise balls, ankle sprains from jumping rope.
186,544	**Soccer** - Twisted ankles or knees after falls, fractured arms during games.
164,607	**Swimming** - Head injuries from hitting the bottom of pools, and leg injuries from accidentally falling into pools.
96,119	**Skiing, Snowboarding** - Head injuries from falling, cut legs and faces, sprained knees or shoulders.
85,580	**Lacrosse, Rugby**, & other Ball Games - Head and facial cuts from getting hit by balls and sticks, injured ankles from falls.

Source: Baby Boomer Sports Injuries, U.S. Consumer Product Safety Commission

Key Industry Focus of Client X



Robert Hale & Associates

BUILDING BRAND AND MARKET SHARE