Stratasys, Ltd., executives Jim Bartel, Jon Cobb, Jeff DeGrange and Sharon Steinhoff Smith

Eden Prairie firm: Minnesota can be a leader in new manufacturing technology

A Civic Caucus Focus on Competitiveness Interview

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Present

Jim Bartel, Dave Broden, Janis Clay, Jon Cobb, Jack Davies, Pat Davies, Jeff DeGrange, Paul Gilje (coordinator), Joe Hiemenz, Randy Johnson, John Kemper, Sallie Kemper, Dana Schroeder, Clarence Shallbetter, Sharon Steinhoff Smith.

Background

Stratasys, Ltd., (www.stratasys.com) is a global provider of a range of three-dimensional (3D) printing systems, resin consumables and services. **RedEye, by Stratasys** is the 3D printing business unit of Stratasys, Ltd. Both are located in Eden Prairie.

Jim Bartel is Vice President and General Manager of RedEye, a business unit of Stratasys. Prior to joining Stratasys in 2012, he held senior leadership positions in manufacturing companies focused on the design, development and marketing of proprietary products, as well as contract manufacturing services. His roles have included Director of Marketing at Miller Manufacturing Company, Vice President of Marketing for ATEK Companies and President of ATEK Products, LLC. He has experience with hardware and software products, including cloud-based systems, serving many vertical markets such as medical, automotive, aerospace, agricultural, oil and gas.

Bartel earned a B.A. in Economics and Management from Hartwick College in New York and an M.B. A. in Marketing from the University of Saint Thomas.

Jon Cobb is Executive Vice President of Global Marketing of Stratasys, Ltd., the position he has held since 2010. Cobb also held the position of Vice President and General Manager for the Dimension 3D

printing business unit of Stratasys since January 2002. He joined the company as Vice President of Marketing in August 1995. Before joining Stratasys, he served as Vice President of Sales and Marketing for Westec Security, Inc., and held various management-level sales and marketing positions with Lockheed Martin's Calcomp Division.

Cobb received a B.S. degree from the University of Wisconsin-Madison.

Jeff DeGrange is Vice President of Direct Digital Manufacturing for Stratasys, Ltd.

He joined Stratasys in 2008, after spending 20 years at the Boeing Company, where he led innovative material and process techniques in the areas of additive manufacturing, reverse engineering and advanced manufacturing. He was one of the principal sources to certify and qualify additive manufactured material and processes for flight hardware used on the F/A-18E/F Super Hornet military jets and the 787 Dreamliner production aircraft programs.

DeGrange has a B.S. in Industrial Engineering from the University of Iowa and an M.S. in Mechanical Engineering from Washington University.

Sharon Steinhoff Smith is Vice President of Marketing for Stratasys, Ltd. She has been with the company for more than five years. She has extensive experience in business-to-business marketing and communications. Prior to joining Stratasys, she held marketing management positions at HID Global, a leading manufacturer of ID card printers. She has a B.A. from Winona State University in communications, with expertise in brand management and content marketing.

Summary

Three-dimensional (3D) printing is a very disruptive technology, similar to the early widespread use of computers in the 1980s, say Stratasys, Ltd., executives Jim Bartel, Jon Cobb, Jeff DeGrange and Sharon Steinhoff Smith. Stratasys is a fast-growing, Eden Prairie-based 3D printing company, doing both design and manufacturing of 3D printers, as well as production of low-volume, end-use parts through 3D printing. The products are used for a variety of purposes and industries, including those in the medical field.

Bartel notes that it's a very competitive environment to find people with the skills the company needs. Cobb says the most effective way for government to support the growth of the 3D industry is to fund training in the needed skills as part of the curriculum in high schools and postsecondary institutions. He says elementary and middle school is not too early to introduce some elements of technical and scientific thinking that would prepare students to learn these skills. Cobb says the investment in education would do more to improve Minnesota's competitiveness than spending public money on incentives to attract or keep businesses in various cities in the state.

Cobb says important reasons Stratasys is located in Eden Prairie is that the company started in an incubator corridor in Eden Prairie and that the city has a core of high-tech companies. Smith notes, too, that the company has a large core of very good, long-tenure employees, many of whom live in Eden Prairie or in nearby suburbs.

De Grange says Minnesota, and the U.S. as a whole, could learn from two models, one in Germany and one in Ohio. The German model of teaching applied science requires students to rotate between time in industry and time in school. When the students graduate from university, they are ready to apply what they've learned to various industries. And Ohio has a multidimensional initiative called Ohio Third Frontier that aims to make Ohio the country's largest manufacturing state.

A. Discussion:

Three-dimensional (3D) printing has been around for 25 years. Jon Cobb offered background on 3D printing and on Stratasys during those 25 years. Chuck Hall, who started 3D printing in California, began by helping designers and engineers in the design process. Since that time, Cobb said, 3D printing has proliferated from the lower end of the consumer marketplace all the way to medical applications, such as body implants, and to various manufacturing uses. It's used in a wide variety of processes and industries.

The 3D printing technology varies some by company, but the principle is the same. The process starts with some type of data, which is either created using computer-aided design (CAD) or data that's scanned by computer. Then the data is sliced into thin layers, usually around 1,000th of an inch down to 10,000th of an inch.

Once the layers are sliced, he said, 3D printers print the object layer upon layer. "If you take a particular layer and build it up," he said, "then you end up getting a part. In our particular case, most of the parts we make are made out of some type of plastic."

Cobb described three different methods used to produce the layers used in the 3D production process: one uses thermoplastics, one uses photosensitive plastics that include rigid and rubber-like materials, and one uses a wax-like material. He described the processes as similar to "a factory in a box" and said metals may be used in the future.

3D printing content comes from variety of places. Cobb said early on, concepts were developed with sketches done on paper. He said 3D content today comes from virtual design, the medical field, 3D scanning and free modeling, such as Google SketchUps. He said there is also a lot of untapped potential opportunity in the architectural community. The 3D printing process moves from concepts to prototypes and then into the production process.

There are about 70 3D printing companies in the world. Stratasys both designs and makes 3D printers to sell and uses them in its own printing production unit. The printers range in cost from $1,000 to $500,000. Stratasys was the fourth or fifth company involved in 3D printing, starting 22 years ago. Since then, Cobb said, the company has either merged with or acquired a number of companies. In December 2012, company merged with an Israeli competitor, Objet Geometries, and became Stratasys, Ltd.

Stratasys has about 11 or 12 primary competitors in 3D printing. There are about 70 3D companies, most of them small, with a number located in China. Most are U.S.-based, with a few in Europe and Israel. Jim Bartel said the 3D printing industry is growing fastest in Asian countries, especially in

China, which has outspent the U.S. by a large amount in helping to develop the technology. He said 3D printing is bringing some jobs back to the U.S. to allow better control over the manufacturing process.

Stratasys has many different customers, ranging from Fortune 1,000 companies to one-person shops to people using it as a hobby. Cobb said a lot of industries use 3D printing: "If someone can design it, if someone can think about it, someone can print it."

Jeff DeGrange said the 3D technology is being used in two different worlds: for making prototypes for product development and for manufacturing, i.e., for making parts other industries need. He focused his comments on its use for manufacturing.

3D printing is a very disruptive technology. "We're in the emerging stages," DeGrange said. "I see it as being a very disruptive technology, like computers were back in the early '80s." But, he said, there are a number of things that have to happen before it is adopted into mainstream manufacturing:

· The community needs more information about what 3D printing is and how to apply it. The majority doesn't understand how to use it in manufacturing. They need more design information, more material property information from credible sources and predictive software tools on how to analyze parts before they are actually made.

· The community needs to know how fast the 3D machines are and whether they can build parts cost effectively. Now the machines can build hundreds or thousands of parts, but not hundreds of thousands. As the machines get faster, the number of parts built will go from 5,000 to maybe 100,000 parts.

· Companies must look at the cost of parts coming out of 3D printing compared with traditional manufacturing. As time goes on, the cost of materials and 3D machines will go down. That will push out the number of parts it makes sense for industries to make through 3D printing.

In response to a question about where people are working on the science of 3D printing, DeGrange mentioned several industry groups in the U.S. and Europe; big companies working on their own, but not sharing the information; some universities, such as the University of Texas, Georgia Tech, and the University of Louisville (Kentucky); and the Department of Energy. He pointed out the University of Minnesota is not involved in this work.

Jim Bartel said Red Eye, the 3D printing unit of Stratasys, also located in Eden Prairie, uses the 3D printers that Stratasys manufactures and designs to actually make low-volume, end-use parts for customers. He said Red Eye is doing more of that all the time, including in the medical world.

It's a very competitive environment to find people with the skills the company needs. Bartel said Red Eye is hiring across the board: sales people, mechanical and electrical engineers, machine operators (although, even though the company has 90 3D printing machines going 24/7 at Red Eye, it needs only two machine operators per shift), customer service people, and technicians with computer-aided design (CAD) skills.

He said employees must have CAD skills, writing skills, basic English language skills, and the mostly self-taught design skills for additive manufacturing, another term for 3D printing. Bartel said these

skills should be taught at both the high school and college levels and promoted the use of more internships and apprenticeships.

The U.S. could learn from the German model of teaching applied science. DeGrange said he likes the German model of teaching applied science by requiring their technical people, whether in engineering or material science, to rotate going into industry and then back to school, etc. "When these students graduate from university," he said, "they really know how to apply the technology for industries." He believes the U.S. could learn from the German model.

When asked what schools Stratasys employees come from, Bartel said some come from the University of Minnesota, although those students don't have additive manufacturing-specific skills; the University of Wisconsin, both Madison and Stout; Dunwoody; from local vocational institutions; and from all around the country.

He pointed out that the company does tours every quarter for students from the University of Wisconsin-Stout. "They don't have the exact courses or curriculum, but the students are so interested that they're doing it on their own," he said. "These are the people we want to be hiring."

Stratasys started in an incubator corridor in Eden Prairie and the city has a core of high-tech companies. In response to a question about why Stratasys has decided to be located in Eden Prairie and to stay in Minnesota, Sharon Steinhoff Smith said the company was founded in Eden Prairie and has a core of employees with extremely long tenure. "Many employees have come to the company and have grown with it," she said. "One reason the company stays here is that we've got good employees who do great work and like to be here."

Smith also said Eden Prairie has a core of high-tech companies. "We have grown tremendously even in the last two or three years," she said. "We have the main building, the Red Eye building and three or four other buildings and we're continuing to expand. But we're trying to stay in the Eden Prairie area to keep our campus together." She said Stratasys did not build the buildings itself.

Cobb added that the company originally started in an incubator corridor in Eden Prairie, which was partially funded by the University of Minnesota. "A key component of the company being in Eden Prairie and probably being in Minnesota was this incubator model set up on Hwy. 169," he said.

Business incubators are organizations geared toward speeding up the growth and success of startup and early-stage companies. They're often a good path to capital from public and private investors and provide access to services like accountants and lawyers and to coaching and networking connections through the staff and other entrepreneurs at the incubator.

A technical skills cluster allows Stratasys to hire good employees from other companies nearby. An interviewer commented that he thinks skills clusters are more important than business clusters or technology clusters. Bartel responded that the company is able to hire people from other companies because their technical skill sets transfer.

In response to a question, Bartel said Stratasys employees come mainly from Eden Prairie and other relatively close suburbs, such as New Prague, Orono, Victoria, Chanhassen, Chaska, Waconia, Savage and Prior Lake.

Stratasys has 1,600 employees worldwide, with 450 in Eden Prairie. Red Eye has 65 employees. The company has had 16 percent employee growth this year and is looking at the same growth next year.

NAMII is an initiative to set up additive manufacturing technology centers around the country. In response to a question, DeGrange said President Barack Obama brought up the National Additive Manufacturing Innovation Institute (NAMII) in a speech in February 2013, where he talked about leveraging additive manufacturing and 3D printing in order to restore manufacturing in the U.S.

DeGrange said three people from Stratasys serve on the NAMII board and explained that the only NAMII technology center set up so far is located in Youngstown, Ohio. People can come in to the center, which has additive manufacturing technology, and understand the technology and how they can apply it to their business. NAMII wants to put in other centers around the country.

DeGrange said Minnesota should be positioned for one of these centers, because the state has such a diversified economy and 3D technology touches 12 different major industries in product development and manufacturing. But DeGrange said he doesn't know whether any individual, group or public agency is actually driving the effort for Minnesota to become a NAMII state.

Minnesota could learn from the Ohio Third Frontier initiative. DeGrange said Ohio would probably be the leading contender for a NAMII center, but it already has the first and only NAMII center in existence in Youngstown. The state has the Ohio Third Frontier (OTF) initiative, which is aimed at making Ohio the leading state in the country for manufacturing. Ohio invests money in workforce development and technology development, with the investments channeled both into large and small manufacturing firms in the state and into the universities.

"I think Ohio is probably a model that Minnesota would want to take a close look at," he said. States like Michigan and Tennessee are looking at the OTF model. He said Ohio is looking at things like the tax structure for corporations and what the right levels of regulation are. "It's multi-dimensional in Ohio and I think they're doing a fairly good job," DeGrange said.

Metal materials are still a very small piece of the 3D printing business, but that might change in the future. Cobb said most of the activity today is in thermoplastics. Stratasys is looking at possibly using s in the future. He said metal is interesting, but there is still huge opportunity in the thermoplastic area that hasn't even been scratched yet.

An important contribution public policy could make is to address issue of adding training in CAD and 3D printing to the curricula of high schools and postsecondary institutions. An interviewer asked what things could be done in the public policy area or what the public policy barriers are that could be addressed to move this technology forward. DeGrange said the big area is how to drive this into the educational sectors on multiple fronts: (1) How do we set up the vocational schools so the students will understand CAD? and (2) How do we drive training in this technology into the high schools?

In response to a question, DeGrange said there are simple, inexpensive 3D printing machines that could go into high schools. Cobb said Stratasys has installed 3D equipment into elementary schools, high schools, four-year universities and two-year technical colleges, especially in the South. DeGrange said there are some initiatives, but it needs to be on a larger scale, perhaps even in the

middle schools. "What can we do to really instill the right kind of thinking and use of these new technologies in schools?" he asked. He noted that the students are very tech savvy already.

An interviewer asked if there is a way that Stratasys can have influence on decisions made in public education from preschool to high school, at the university level and in vocational schools, such as helping develop the curricula and influencing the way teachers are trained.

DeGrange said NAMII offers an opportunity to have some influence, but said the company has no voice with the National Science Foundation. Smith said the company does more work at the individual school level. Stratasys engineers work with a science camp that brings in 100 students. The company has an extreme redesign competition for middle school, high school and college challenging students to design new ways of doing things.

Public money going into education, rather than into incentives to keep or attract companies, helps improve the competitiveness of the U.S. and of Minnesota. An interviewer asked whether public money should be invested in attracting businesses or business expansion, using things like tax-increment financing (TIF), or, instead, should it be invested in the schools. Cobb said if we're trying to improve the competitiveness of the U.S. and of Minnesota, money going to education puts the state and local cities into a better competitive environment.

The other type of public investment, he said, is to bring jobs into a certain area. "This company hasn't played that card at all," he said. He said Stratasys is a good business for a community to have, since it's a clean company and offers high-paying jobs in manufacturing, science and math. "It's important for the city of Eden Prairie and Minnesota to keep a company like ours here," he said.

An interviewer asked how much the tax environment in Minnesota affects the company's decision about staying in the state. Cobb replied that Stratasys is now an Israeli company and that one factor in that decision was that taxes in Israel are much lower than in Minnesota or the U.S.

In response to a question about the impact of the regulatory atmosphere on the 3D printing industry, DeGrange said the company's manufacturing is very clean, so environmental regulations are not an issue.