FOCUS ON MANUFACTURING

Helping Tennessee companies achieve a sustainable competitive advantage — Summer 1998

Shifting the corporate gears: Flint Hydrostatics retools its long-term planning

INSIDE:

Imagine you're in charge of excavation on a large construction project. One of your bulldozers just shut down, and your company is facing penalties if the work isn't completed on time. Or, imagine you're a small farmer whose crop is ready for market, but your harvester is out of commission.

These situations represent what's on the line every day for Flint Hydrostatics, Inc. (FHI). The Memphis remanufacturer of hydrostatic transmissions supplies units for heavy machinery used in industries such as agriculture, construction, manufacturing and utilities. Customers return their old transmissions to FHI where they are completely disassembled and remanufactured. The transmissions FHI sells are like-new products, made to OEM specs using remanufactured, Flint-new, and OEM parts.

President Frank Gafa describes the processes used to finish some of the parts manufactured by FHI

Obviously, quality is a critical concern. But delivery time plays an equally important role in customer satisfaction, especially since FHI aims for same-day or next-day shipment of orders.

The best laid plans.....

FHI was doing pretty well, but in 1996 president Frank Gafa took a crucial step to help insure the company's continued growth. Gafa takes very seriously his responsibility for piloting the company's course, and he knew at least one significant issue needed attention if it was to remain successful.

"We were more reaction-oriented. We needed better planning to help maintain a steady flow of product," Gafa says.

Because of the type of work done by its customers, FHI's sales are seasonal with the greatest demand coming during summer. In fact, what FHI needed was a more sophisticated ability to plan, produce and stock inventory to fill customer orders during busy periods. But maintaining the right mix in an inventory of more than 500,000 parts is a daunting task.

Gafa had already taken FHI through a strategic planning process, but he felt the results didn't really support the company's mission. However, having worked previously in strategic planning for a large manufacturer, he knew its value and decided to try again.

Oh, no, not another consultant

Gafa called on Al Cash of CIS's Tennessee Manufacturing Extension Program to help find a strategic planning specialist who was knowledgeable on the issues facing FHI. Cash, in turn, brought in Craig Blackman, director of graduate engineering management programs at Christian Brothers University.

Even though he had experience in strategic planning, Gafa believes it was valuable to have outside assistance in guiding the planning effort.

"Having an outside leader really helped move the process along, and it allowed me to be an active participant right along with our managers," Gafa said. "We also benefited from [Blackman's] exposure to other businesses and their problem solving experiences."

Blackman agrees and says it is essential to find a facilitator who can put the staff at ease.

"I had to first convince the team that I was there to help the company, not just the management, and that this process wouldn't hurt the workers," he said. "Once they felt confident with me, we were able to move forward."

Starting on the right track

Following several lengthy discussions about FHI's

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Produced by T·M·E·P
The Tennessee Manufacturing Extension Program

Be a lean machine: Take a closer look at your operations to squeeze out greater profits

By Chuck Beasley, manufacturing consultant
Tennessee Manufacturing Extension Program

Like most companies, yours is probably always looking for that edge that will give you a competitive advantage—today and for the future. Customer order lead times are being reduced, profit margins are shrinking, and quality criteria are being tightened. One area in which many companies are focusing to meet these demands is Lean Manufacturing. It's also called Agile Manufacturing, Lean Production Systems, Just In Time, and even Flexible Manufacturing. The name is not really important. What is important is that in today's competitive market your company takes steps to continuously improve itself.

Lean Manufacturing can be applied throughout your plant. It just takes a keen eye, common sense, some knowledge of Lean Manufacturing principles, and, most important, teamwork.

Just what is Lean Manufacturing? The "Toyota Production System" created by Taiichi Ohno of Toyota Motor Corporation is the cornerstone of lean manufacturing. It was developed more than 30 years ago and is still making waves in manufacturing facilities to this day. No matter what we call it, lean manufacturing boils down to removing the waste from your process. Think about where there is waste in your facility. Inventory, changeovers, and material handling all provide opportunities for improvement.

Lean manufacturing is not a quick fix. It is a continuing process of eliminating waste that involves everything from supplier development to evaluating customer returns. It can take years to refine this process in your plant. Remember, the objective is to eliminate waste in your process. Can you think of an area in your plant that runs perfectly with no real or potential waste of manpower, methods, or capital? Probably not! Just think, every area of your plant has potential improvements to be gained. So how do you go about accomplishing this great task?

What you can expect from the "lean life"

First, you should be aware that your company must have the proper culture for implementing the system. Personnel must be trained in problem solving techniques and teambuilding, and they must be empowered to make decisions on the shop floor.

If the appropriate culture is in place or is being implemented, then the next step is to begin looking for waste to eliminate. Some companies attempt to use Kaizen blitzes to implement lean manufacturing. Kaizen efforts usually provide only quick glimpses of improvements in focused areas that the company wants to achieve plant-wide.

It doesn't matter whether you are running a job shop or a mass production business, waste can be removed from your process. The concepts can be implemented in any type of manufacturing by streamlining the flow through the shop floor with the proper equipment and layout. You also can reduce or eliminate material handling between operations. Organizations that have implemented lean manufacturing have seen some significant results:

- Reduction in floor space by 10-30%
- Reduction in inventory by 50-80%
- Reduction in lead times by 50-90%
- Reduction in scrap/rework costs by 20-50%
- Increase of production output by 40-80%

Books like James Womack's *The Machine that Changed the World* and *Lean Thinking* have documented these results in numerous case studies. It was all accomplished just by using good, basic industrial engineering principles and removing process waste. Inventories are reduced by implementing pull production systems. Changeover times are reduced by implementing quick setup principles. Processes are streamlined by using cellular manufacturing, workplace organization and visual controls. Problems are thought of as opportunities and challenges. All of this leads to a more productive and profitable workplace.

The Tennessee Manufacturing Extension Program has developed five highly interactive classes to help

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The looming Y2K problem

Maybe you really should worry

By Walt Williams, electronic commerce consultant
Tennessee Manufacturing Extension Program

Don't get caught unprepared! It's critical that you find out now if your company's computer systems are Year 2000 compliant and what to do if they're not.

Most large companies have the technical resources to address Year 2000 (known affectionately as Y2K) issues. Very small companies may incur only the expense of replacing a few computers and their business software. It's the mid-size companies that may be hit hardest due to lack of technical and financial resources. They also are the most likely to be reactive rather than proactive, and Y2K isn't a priority. Yet.

Unfortunately, the cost of Y2K compliance will probably increase between now and late 1999, and those who have the know-how to help will already be committed. The message? Act now!

Q: First of all, what is the Year 2000 (Y2K) problem and why is it a concern?

The millennium bug, or Year 2000 date problem, refers to a flaw in the way dates traditionally have been entered into computer systems. Many computers that use two digits to keep track of the date will, on January 1, 2000, recognize the double zero not as 2000, but as 1900. Since computers use dates to make calculations, this glitch could cause them to shut down or generate erroneous information. The risks include everything from corruption of critical data to the complete shutdown of networks, automated manufacturing, and essential operational systems.

Q: What areas in the computer environment are vulnerable?

A common misconception about the problem is that firms with PC-based workstations and relatively current servers are safe; only companies with older mainframes really have a problem. However, according to some reports, nearly 50 percent of PCs shipped in early 1997 still failed year 2000 rollover testing.

Even firms that are addressing Y2K compliance may be overlooking potential problems embedded in other systems such as machine controllers, security systems, sprinkler systems, HVAC, and elevators.

Q: What kinds of issues should a company examine to identify its vulnerability?

First, take an inventory of all of your hardware, software, data, and interfaces. You also should look at your operational requirements and relationships with suppliers and customers.

Next, contact the vendors and suppliers of inventoried items and ask for a written statement verifying that each item (hardware, software, or service) is Y2K compliant. Otherwise, they should offer an upgrade or replacement product.

If you have a custom software application, and the vendor doesn't have an upgrade or no longer supports the product, you face a difficult decision. You must weigh the costs and benefits of rewriting the custom code to become compliant or replacing the program with a compliant application.

Q: An outside vendor does my accounting and payroll. Should I be concerned?

Yes. Just as you would confirm Y2K compliance of product suppliers, you should confirm the compliance of service providers. If your service providers (payroll, accounting, insurance, financial, utilities, etc.) can't verify compliance or state of compliance, consider alternative outsourcing arrangements, if possible.

Q: What's the first step for a small manufacturer who doesn't have an information technologist (IT) on staff?

Keep in mind that the Year 2000 problem affects all aspects of your business; it's not just an IT problem. The first step is to assemble a Y2K project team or an individual to oversee the effort. The team should have knowledge of your firm's business activities. Charge the team with conducting an initial inventory of all your company's hardware, software, and data. With that information, you can begin assessing your company's Y2K vulnerabilities.

Q: What's the worst that could happen if I just ignore the problem?

If you ignore the Y2K problem, you run the risk of going out of business! You may lose critical data necessary for daily business operations. Problems with your environmental controls, telecommunications, utilities, security systems, or production automation may force you to close your plant. Failures in manufac-

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As of 1997, 88 percent of all companies with fewer than 2,000 employees had not yet started Year 2000 remediation projects.
Gartner Group Study, 1997

Nearly 50 percent of PCs shipped in early 1997 still failed year 2000 rollover testing.
Greenwich Mean Time Study, 1997

An estimated 50 million devices out of 25 billion embedded in automated systems are not year 2000 compliant.
Gartner Group Study, 1997

TIBBETTS AWARD

The Tibbetts Award was established in 1996 to honor companies, projects, organizations and individuals that exemplify the very best in SBIR impact and achievement.

Stories submitted in support of the nominations are as varied as the parts of the county from which they come, the developmental stage of the projects and the types of technology involved.

What they all have in common is that the availability of SBIR resources was a key factor in enabling:

- Creation of new firms and new jobs
- Strengthening of small companies
- Important technologies to be brought to use-condition
- Technological breakthroughs in many fields
- Collaborations that might not otherwise not have developed
- Important niche markets to be well served
- Substantial growth of international trade

Some Tennessee winners of the Tibbetts Award are:

National Recovery Technology (Nashville) 1996

Team: **LoFLYTE c/o Accurate Automation Corp.** (Chattanooga) 1996

Atom Sciences (Oak Ridge) 1997

Government money, continued from back cover

commercialization of its product, the federal government makes all reasonable efforts that it can to ensure technology developed under the SBIR program is commercialized. It can even do a sole-source contract with the same small business that originally developed the technology.

STTR — the other program

The STTR program is modeled after the SBIR program, but only five agencies currently participate: the Departments of Defense and Energy, NASA, the National Science Foundation, and the Public Health Service.

Phase I of an STTR award is for one year and up to $100,000 to determine the scientific, technical and commercial feasibility of the pro-posed cooperative effort. Special emphasis is placed on commercialization potential.

A Phase II STTR award can be up to $500,000 for a two-year period to further develop the concept. Phase II selections are based on the results of Phase I work and the technical merit and commercial potential of the proposal.

Phase III is, as in the SBIR program, where the small business obtains funding from private sector sources or federal agencies outside the STTR program to commercialize the technology.

Are you qualified?

To participate in either program your company must first qualify as a small business. The definition, from the Small Business Administration, states that a small business is independently owned and operated, organized for profit, has its principal place of business in the United States, is at least 51 percent owned by U.S. citizens, and has no more than 500 employees.

Surface Treatment Technology (STT) is a new small company in Tullahoma. It currently has several SBIR proposals under consideration for a new technology — Laser Induced Surface Improvement — invented at the UT Space Institute. STT's president, Dr. Jim Mitchell, is an old hand with the SBIR program having responded to several solicitations over the years. Here are some of the lessons he's learned:

"Phase I SBIRs are a good way for a small business with limited resources to get enough money to demonstrate that new ideas are feasible. Government applications often parallel those in private industry, and the ability to transfer your technology to the private sector is very important. The key to a Phase II award is to team up with a potential user of the technology who can augment the SBIR funding and help you turn your idea into a growing business."

"It pays to get out and talk to the people in the agencies before the solicitations are written. In many cases, they already know the solution they're seeking, and they direct their solicitations toward a specific technology. "

"The win ratio for Phase I SBIRs is about one to 10 or 11. **Don't get discouraged if your first proposal isn't funded."**

For more information ....

The Small Business Administration (SBA) is the primary federal advocacy office for small companies. It also oversees both the SBIR and STTR programs.

The SBA web site at www.sbaonline.sba.gov/expanding/ is a good place to find general information about the SBIR and STTR programs. From the SBA site you can go into each of the participating federal agency web sites and check their solicitations as well as find out who was awarded contracts and grants from previous solicitations.

Join those in the know

There are several national conferences held to introduce the SBIR/STTR programs to small businesses involved in research and development. These conferences offer practical business seminars and elaborate on aspects of participation in the program. The next national SBIR conference will be held at the Hynes Convention Center in conjunction with the NASA 2008 conference in Boston, Massachusetts, on November 3-5. Check the meeting web site at www.zyn/com/sbir for more information on this meeting. You can find out about the Spring National Meeting at www.seeport.com. ■

The UT Center for Industrial Services provides guidance to companies considering applying for SBIR/STTR awards. For more information, contact the Center at (615) 532-8657 or toll-free at (888) 763-7439.

How do you measure up?

Find out how well you're positioned to compete for business in the areas that count with your customers

OEMs and first-tier suppliers are putting more emphasis than ever on working with suppliers who can remain competitive. While they all have different approaches, they share a focus on one issue: continuous improvement.

Nissan Motor Manufacturing Corporation, for instance, works with suppliers in nine "activities," including line processes, material handling and control, quality and quick changeovers.

"What we're trying to get across to our suppliers is that you can't be competitive without improving," said John Anderson, Nissan's manager of the supplier development section.

Jack Sisk, supplier quality coordinator at Saturn Corporation, echoes that when he says, "The suppliers we work with are those that have goals for improvement, that are always trying to improve their processes and their quality."

Saturn operates an extensive supplier development program that focuses on helping its suppliers improve first-time quality, process capabilities, and production capacity and efficiencies.

"Any company that wants to be in business in 20 years or 50 years has to be looking constantly at improving," said Sisk.

If you're a smaller manufacturer who wants to develop or increase your business with large companies such as these, it's important to know where you stand in relation to their expectations.

As Anderson said, "If you're not competitive, you're not going to be selling to Nissan."

Well, how DO you measure up?

The Tennessee Manufacturing Extension Program (TMEP) is helping smaller manufacturers define just how competitive they are, then take steps toward improvement. The process begins with an evaluation called the Competitiveness Review (CR). The CR was developed from a number of OEM supplier certification programs and international standards to help you create a thorough profile of your company's strengths and areas for improvement.

With the CR, you will find out exactly how your company rates in six critical categories: management, quality, technical capability, delivery, cost management, and environmental management.

It gives you a *lot* of information.

"Using the CR findings, the company can determine which areas should be priorities for improvement and in which areas they're already operating competitively," said Ron Rader, the TMEP's supplier development consultant. "With this information we can help the company create a systematic plan for improvement with specific targets and goals."

Rader also emphasizes the value of the CR in building customer relationships.

"The fact that your company has gone through this process and is working on making changes shows current and potential customers that you share their concerns for continuous improvement," Rader said.

The CR is just the beginning

The staff at Aqua-Chem in Knoxville recently evaluated their operations using the Competitiveness Review. David Abbott, the company's vice president and general manager, sees it as a good way to view themselves through the eyes of a third party.

"Like all American industries, we're now competing on a worldwide basis," Abbott said. "This is a tremendous opportunity to have people who have seen hundreds of other companies tell us honestly how we compare."

Abbott also recognizes that the CR doesn't lead to a simple solution to any company's problems. "There's never just one problem, and there are no silver bullets. We have to work continuously on all the small things."

Other companies have gained different benefits from the Review. For instance, Ron Smithfield of Smithfield Manufacturing, Inc., in Clarksville says the CR was a good step to help his company prepare for ISO 9000.

But regardless of a company's intent, the real value of the CR is in the follow-through — the development of priorities and implementation of continuous improvement measures. ■

For a better look at the TMEP Competitiveness Review, contact the Center for Industrial Services at (615) 532-8657 or toll-free at (888) 763-7439.

Ron Smithfield (right) used the CR to help prepare Smithfield Manufacturing for ISO 9000.

Focus On Manufacturing is published quarterly by the **Tennessee Manufacturing Extension Program**, Tennessee's assistance program for small and medium size manufacturers.

An affiliate of:

MANUFACTURING EXTENSION PARTNERSHIP℠

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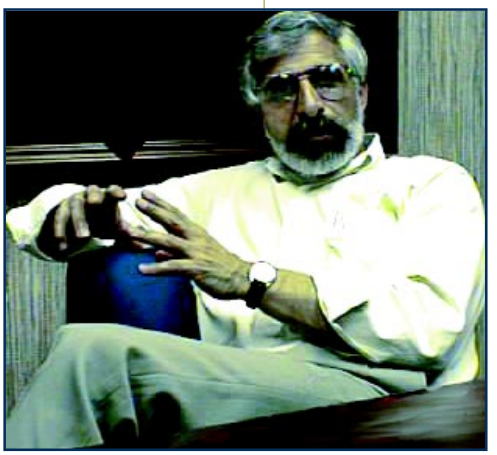
www.cis.utk.edu

Flint Hydrostatics, continued from page 1

needs and Gafa's expectations, Blackman recommended that the firm's planning sessions be structured around *The Balanced Score Card* developed by Harvard professor Robert Kaplan. *The Balanced Score Card* is a framework for measuring performance in four critical, interrelated areas: the customer, financial management, internal business processes, and learning and growth. It demands that the company embrace a corporate vision that links individual efforts to business objectives. And, it incorporates continuous review of successes and opportunities for improvement.



"The company has increased sales by 10 percent above original growth projections due to improvements made as a result of better planning and teamwork."

That may sound like a lot of fancy "consultant talk," but the FHI team found it to be a valuable exercise. Gafa says it really brought to light the dependence of each operations area on the others. It required each of the firm's managers to develop operational goals and measurement criteria that related directly to the company's mission. And it provided a structure for monitoring and assessing performance gaps so they can be corrected before serious problems develop.

In the second year following development of the strategic plan, FHI has taken the same discipline and refined it to, as Gafa says, "make sure our ship is in order."

"This year's strategic planning is directed toward key programs that must be completed to fulfill our corporate mission and position FHI for growth," said Gafa.

Recognizing that the operations side must run smoothly for the strategic plan to work, the company has focused attention on nine operations areas. Among the changes FHI is making as a result are:

- Expansion of manufacturing cells to increase production capabilities
- Reevaluation of the entire inventory system and scheduled installation of a bar coding system
- Identification of multiple vendors to insure availability of parts and raw materials
- Reorganization and reformatting of technical information to improve customer service

Everybody out of the box

Flint Hydrostatics did two other smart things that were instrumental in the continued success of its planning efforts.

From the beginning, Blackman emphasized the importance of proper preparation. In the case of FHI, this meant that each of the company's managers, including Gafa, took the Myers-Briggs Type Indicator and underwent a "360-degree" evaluation by the other members of the planning group. These assessments helped everyone better understand their own and their co-workers' approaches to work, management and problem solving.

"I know it has improved our working relationships simply because we know each other better," said Gafa. "We all had become so programmed over time on how we approach planning and our day-to-day operations. Allowing ourselves to be creative and step out of the box we'd put ourselves in has let us look at things in new ways."

Blackman also strongly recommended preparatory supervisory training for team members.

"FHI's preparation through personal evaluations plus training really paid off," Blackman said. "Because of the work they did on the front end, everybody was ready and on the same page when it came time to tackle *The Balanced Scorecard."*

Second, because of the interrelations discovered among the operational areas, managers were assigned to project teams in areas outside their daily duties. For instance, the sales manager is working on two projects in the plant, and the manager of corporate development is working on standards. Gafa believes this has improved operations overall because staff in each department now understand how others in the company depend on the work they do and how their actions can affect a long chain of events.

The proof is in the profits

Gafa says the first year after it completed and followed through on the *Balanced Scorecard* planning exercise, FHI experienced sales growth far greater than planned. The company has increased sales by 10 percent above original growth projections due to improvements made as a result of better planning and teamwork.

"I feel that we're now supporting our mission statement," Gafa said. "This is only the first step in a long journey, but we have confidence we're setting the right goals, and we're accomplishing them." ■

Lean manufacturing, continued from page 2

local plants start on the road to becoming lean manufacturers. The classes are delivered in your plant with hands-on activities to demonstrate the concepts of lean manufacturing. These five classes provide the building blocks for lean manufacturing:

- Lean Manufacturing Overview
- Pull Inventory Systems
- Standardized Operations
- Quick Changeover
- Workplace Organization and Visual Controls

Down to basics

The books cited can show you what lean manufacturing does. However, they never seem to get to the nuts and bolts of how to actually create a lean organization.

Whether your company is well on the road to becoming a lean organization or you're just thinking about getting started, remember, this is not rocket science. You simply analyze the process and remove the waste in it. The goal is to produce just what is needed, when it is needed, in only the amount needed ….. at a profit, of course! ■

For more information about the Lean Manufacturing training series or how to implement Lean Manufacturing in your plant, call the UT Center for Industrial Services at (615) 532-8657 or toll-free at (888) 763-7439.

Year 2000, continued from page 3

turing, shipping, invoicing, processing or receiving orders and payments may threaten client relationships.

Q: Are there some simple solutions?

There is no simple path to full Y2K compliance. However, the less your company depends on microprocessor-embedded systems and computer software and external relationships, the smaller your Y2K problem. There are software tools that can help you assess whether your systems are compliant. But assessing the problem is just the beginning. Defining and implementing a comprehensive Y2K compliance project gets you moving in the right direction.

Q: What kind of contingency plans should a smaller company put in place?

Your Y2K compliance project must include a contingency plan. Some things you should consider: look at your day-to-day business activities and determine which operations are mission critical. Consider how you would conduct business if that operation were not available as of January 1, 2000. Print and back-up all computer-generated data and operational files. Determine alternate, non-automated means of making your products in the event your automated processes are interrupted. Make sure all your suppliers and vendors are Y2K compliant and will continue to provide necessary materials, services, and assistance you need to keep operating.

Q: What kind of help is available?

From PC-based Y2K software assessment applications to full-service project management products and services, a large array of products and services exists to help companies of any size.

First, take a few minutes to complete the Y2K Self Assessment developed by the NIST Manufacturing Extension Partnership. It's on the Internet at www.mep.nist.gov/hottopics/. (Or, we can send you a copy.) Then call us at (615) 532-8657 or toll-free at (888) 763-7439 if you'd like help getting started. ■

CALENDAR

Aug. 4-13: Tennessee Environmental Regulatory Overview Seminar, Chattanooga, Jackson, Johnson City, Knoxville, Memphis, Nashville. Find out which regulations apply to you and how to comply. Plus, learn about recent changes and what they will mean to your operations in this one-day seminar. Contact Lynn Reed at (615) 532-8883.

Aug. 11-13: SAE Southern Automotive Manufacturing Conference & Exposition, Nashville. "Total Quality Manufacturing" is the theme for this special conference for automotive manufacturers and suppliers. Technical session topics include lean manufacturing, concurrent product development, environmentally conscious manufacturing and developing good supplier partnerships. Exhibitors from more than 100 companies will discuss their products and services. For registration information call SAE at (724) 776-4841, or visit their web site at www.sae.org.

Sept. 30-Oct. 1: East Tennessee Industrial & Machine Tool Show, Knoxville. Industrial heaven! If fork lifts, electrical equipment, machine tools and fancy pumps make you happy, you're going to love this show at the Knoxville Convention Center. Visit the TMEP booth while you're there. For free admission, contact the TMEP at (615) 532-8657 or toll-free at (888) 763-7439.

For a complete schedule of CIS courses, call (615) 532-8657, or visit our web site at www.cis.utk.edu.

Y2K On The Web

There are many informative sites on the Internet from which you can learn more about Year 2000 issues. These are a few of them:

Year 2000 Information Center:
www.year2000.com

Year 2000:
www.mitre.org/research/y2k

Test Your PC System Clock:
www.mitre.org/technology/cots/TEST.html

Hardware Compliance Test:
www.rightime.com

Freeware for Analysis:
www.bozemanlegg.com/y2kanalyzer.html

Microsoft:
www.microsoft.com/Year2000

Y2K Supplier Questionnaire:
www.cis.utk.edu

Psst .... the federal government wants to give you money

By Terrye Whitaker, SBIR/STTR specialist
UT Center for Industrial Services

If you have a small to mid-size company, or if you're an entrepreneur with a product idea but little money to research it, there are two important programs that might be of help to you. These programs provide venture capital for you to explore your ideas and require neither equity nor payback. They fund early stage, high-risk development projects that no one else will touch. And, they let you research your ideas and gather data that can bring in other sources of capital to help you commercialize your new product.

And these wonderful programs are .....

The first of these too-good-to-be-true programs is the Small Business Innovation Research (SBIR) program. SBIR was designed to stimulate technological innovation among small, private-sector businesses while providing the government with new, cost effective solutions to challenging problems. It also encourages small businesses to market the newly developed technology in the private sector to stimulate the U.S. economy.

The second program, Small Business Technology Transfer (STTR), was created to fund cooperative research and development (R&D) projects. It is intended to encourage collaboration between two powerful forces for technological progress: the entrepreneurial talent of the high-tech small business and the innovative ideas, science and engineering expertise of the nation's universities and other research institutions.

Both programs are targeted at small businesses. In creating them, Congress hoped to lessen the R&D advantage large companies had over small businesses. The government's front-end funding of new ideas to help solve critical agency problems and the special opportunities to commercialize these ideas helps offset the risky nature of R&D while lowering the risk for private investors. Hundreds of small businesses across the country, including many in Tennessee, have already obtained public and private sector contracts through the SBIR and STTR programs.

Locking in to SBIR funds

Ten federal agencies — the Departments of Agriculture, Commerce, Defense, Energy, Education, Health and Human Services, Transportation, and EPA, NASA and the National Science Foundation — are required to set aside a portion of their research and development budgets exclusively for SBIR contracts. Each year these agencies publish "solicitations" on topics for which they need scientific solutions. (You can obtain solicitations either in electronic format on the Internet or, in some cases, as a bound book.)

The SBIR program is divided into three phases. Phase I is a "proof of concept" phase with awards of up to $100,000 for research efforts lasting up to six months. Phase I winners are chosen competitively by the granting agency's technical and scientific experts.

Phase II awards are given only to Phase I winners. In other words, if you have not received a Phase I award you will not be considered for Phase II. The value of these contracts/grants is up to $750,000. Phase II proposals must address the concept's potential for commercial application.

Phase III involves commercialization of the product with private sector or federal agency funding from outside the SBIR program. Even though the business is ultimately responsible for successful

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