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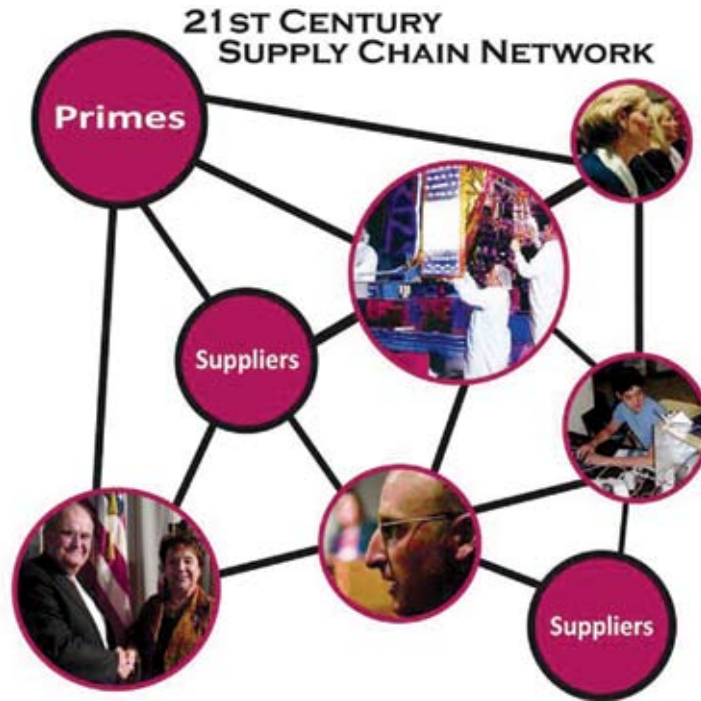
# California Aerospace Supplier Transformation Requirements for 21<sup>st</sup> Century Global Competitiveness:

Characterization of the California Aerospace Supply Base  
Identification of Common Industry Training Needs  
through Surveys, Forums and Industry Input



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## ACKNOWLEDGEMENTS



Governed by a statewide board of directors, the California Space Authority (CSA) is a nonprofit organization representing the interests of California's diverse space enterprise community in all three domains: commercial, civil and national security. Working closely with the State of California, CSA partners with industry, NASA and other government agencies, economic development and workforce entities, education and academia to facilitate a vibrant space enterprise community throughout California.

CSA was the first entity of its kind to develop a comprehensive, statewide Space Enterprise Strategic Plan that engages stakeholders from across the state to address critical issues affecting space enterprise development such as business development, retention and growth; space industrial base vitality; science, research and technology development; education and workforce development; and public and policymaker awareness. In late 2005, the U.S. Department of Labor (DOL) announced a powerful initiative called Workforce Innovation in Regional Economic Development (WIRED) that closely aligned with the strategic objectives and findings of the California Space Enterprise Strategic Plan 2004-2006.

In January 2006, the State of California through the California Labor and Workforce Development Agency submitted the CSA-led WIRED proposal to the DOL. In February of that year, the California Innovation Corridor was spawned as the State of California with CSA as the program lead became one of 13 first generation WIRED regions nationwide selected to assist the federal government in addressing the priorities outlined in the American Competitiveness Initiative. The California Innovation Corridor was originally comprised of 60 plus private and public sector partners spanning 13 counties. The objective of the California Innovation Corridor is to "optimize the Corridor for innovation and 21st Century workforce competitiveness." It is achieving this objective through the implementation of 25 projects that fall under one of three strategic goals: innovation support, industrial rejuvenation, and talent development.

The industrial rejuvenation component of the California Innovation Corridor is designed to improve the international competitiveness of the region's supply chain by developing and executing a "Smart Supplier Strategy" that supports manufacturers, small business and entrepreneurs in adapting to the global manufacturing transformation that is currently underway. CSA is pleased to have a lead role in the Smart Supplier Strategy of which this report is a key deliverable. Ensuring a vibrant and globally competitive aerospace supply chain is imperative to the health and vitality of California's economy and contributes greatly to the national security of this nation.

CSA extends its appreciation to the hundreds of stakeholders representing the government, industry, academia, economic and workforce development entities, who worked tirelessly toward the success of this initiative. In particular, I would like to recognize the dedication and leadership that Christine Purcell, CSA's Manager of Industry Workforce and Manufacturing Development, lent to this effort. CSA looks forward to working with supply chain stakeholders in the next phase to address the issues identified herein, and to create a supply chain that is not only capable of meeting the rigors of international competitiveness, but serves as a model for the 21st century.

Sincerely,

The Honorable Andrea Seastrand  
Executive Director  
California Space Authority

## ACKNOWLEDGEMENTS



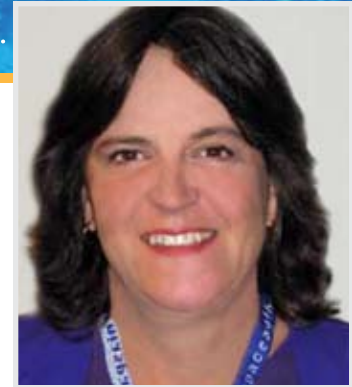
Antelope Valley College is a comprehensive community college established in 1929, serving approximately 15,500 students in the heart of California's "Aerospace Valley." As a partner in the local Mathematics, Science, Engineering and Technology Consortium, AVC is responsive to the educational and training needs of regional business, industry, and public service, as well as the social and cultural needs of the Antelope Valley. Antelope Valley College has programs, such as Engineering and Aircraft Fabrication and Assembly, which are taught in part by engineers from the local aerospace contractors and where the program graduates move into the local aerospace workforce upon graduation. Antelope Valley College strives to keep its courses and programs current and flexible to produce the workers in demand in the aerospace industry. For this reason, Antelope Valley College was offered the opportunity to partner with the California Space Authority on the Workforce Innovation Regional Economic Development (WIRED) grant, with the goal of characterizing foundational "smart supplier" competitiveness skills and articulating a set of common smart supplier program requirements and learning outcomes across supply chain training. The Antelope Valley College Board of Trustees (Appendix A) has continually supported transformation initiatives such as the WIRED grant and seeks to work with industry partners in the Antelope Valley as articulated in the Mission Statement of the college.

AVC's Office of Institutional Research and Planning, along with the Division of Math, Science and Engineering worked collaboratively with CSA, members of Industry and our WIRED partners to develop a comprehensive survey of aerospace manufacturing in the state of California. As an academic institution, our research department conducted the distribution of the surveys and all analysis of the data collected. The Research Office reviewed the results and evaluated the training needs and has begun offering seminars to small manufacturers in the area of supply chain management. The seminars are data driven, with topics and presentations derived from the results of the statewide survey.

On behalf of Antelope Valley College, I would like to thank Christine Purcell and the rest of the staff at the California Space Authority for the opportunity to work with them on this effort of industrial rejuvenation. We would also like to acknowledge and thank all the hard work contributed by all the partners who worked on this project; The Antelope Valley Board of Trade, California Manufacturing Technology Consulting (CMTC), NOVA (North Valley Job Training Consortium) and the University of Southern California Viterbi School of Engineering Western Research Assistance Center (WESRAC). Finally, Antelope Valley College would also like to thank Page Chen, whose hard work and dedication were essential to the successful completion of this project. It was both an honor and an opportunity for the staff and students at Antelope Valley College to help in collecting, analyzing and reporting the results of this valuable piece of the larger effort to transform the aerospace industry. The report that follows is a result of the collaborative efforts of all involved.

Jackie L. Fisher Sr., Ed.D.  
Superintendent/President  
Antelope Valley College

## ACKNOWLEDGEMENTS



California Space Authority (CSA) is pleased to have a lead role in the Supplier Transformation Strategy—a primary component of the California Innovation Corridor initiative, which is funded through the U.S. Department of Labor's Workforce Innovation in Regional Economic Development (WIRED) program, and in alignment with the American Competitiveness Initiative.

With 50% of aerospace manufacturers in California, with 80% of aerospace workers working for companies of fewer than 100 employees and with up to 80% of aerospace systems and innovation coming from the supply base, supply base global competitiveness is critical to California's and the United State's economic and national security. An understanding of 21st century complex dynamic supplier networks, reduced production costs, consistent Supply Chain Management practices and quality metrics, and a capable workforce are key to this success.

Hundreds of stakeholders contributed to the success of this initiative. In particular, the CSA Supply Chain Industry Advisory Group (SCIAG), which served as a steering committee for this initiative, provided valuable inputs into the process, the content, and the delivery of the data accumulated during this project. CSA appreciates the countless hours this group donated to make this effort a success.

CSA would like to extend its appreciation and special recognition to the following: the DOL and the State of California Labor and Workforce Development Agency for the leadership and guidance that these entities provided to the implementation of the California Innovation Corridor initiative; Antelope Valley College, California Manufacturing Technology Consulting, El Camino College, NOVA Workforce Investment Board and University of Southern California Viterbi School of Engineering Western Research Assistance Center (WESRAC), CSA's partners in the Smart Supplier Strategy initiative; its industry collaborators, particularly ACE Clearwater, Aerojet, The Boeing Company, Lockheed Martin Company, Northrop Grumman Corporation, and Raytheon; its government collaborators from The Aerospace Corporation, NASA, the U.S. Department of Defense and U.S. Department of Commerce; professional associations such as the California Manufacturers and Technology Association, the Society of Manufacturing Engineers, SAE International, National Association of Manufacturers and the Supplier Excellence Alliance as well as to economic and workforce development entities including NOVA Workforce Investment Board and the Antelope Valley Board of Trade.

CSA extends special appreciation to Raytheon and Dina Hyde, who functioned as Chair of the CSA Supply Chain Industry Advisory Group (SCIAG) (Appendix F) and co-hosted the second Annual Supplier Transformation Forum in October 2007 while Vice President of Supply Chain Management, Raytheon Space and Airborne Systems, and to her staff including: Sandy Adams, Shirley Patterson

and Paul Dunn, and to Susan Sloan, Vice President of Mission Assurance, Space and Airborne Systems Raytheon Company. CSA also extends its thanks to Dr. Wanda Austin, President and CEO of The Aerospace

Corporation, keynote speaker at the 2007 Forum, and to her staff including Gary Schipper. CSA also thanks Northrop Grumman Corporation for co-hosting the third Annual Supplier Transformation Forum in October 2008, including: Mike McVey, Vice President Supply Chain; Linnie Haynesworth, who held both the Director of Subcontracts and Deputy Program Manager of the NPOESS (National Polar-orbiting Operational Environmental Satellite System) program positions; and Charles Heckrotte, Director of Material.

CSA also thanks Dianna Salgado and Lockheed Martin Company for co-hosting the pilot Introduction to 21st Century Supply Chain Management (SCM) seminar, as well as The Boeing Company and Peggy Berry, Director, Supplier Management, C3 Networks, IDS for co-hosting the second Introduction to 21st Century SCM seminar.

Special thanks to Kellie Johnson, President, ACE Clearwater and Chair of the Space Manufacturing Group for countless realistic insights and Ken Dozier and USC for truly innovative perspectives of 21st century supplier networks. CSA would also like to especially thank Page Chen and Antelope Valley College for not only being the lead on the Smart Supplier Initiative Survey implementation and analysis, but also contributing to all aspects of the Smart Supplier Initiative. CSA also appreciates participation, input and guidance by its members and Board of Directors, (Appendix D) and the California Space Education and Workforce Institute (CSEWI) Board of Directors (Appendix E).

Lastly, CSA thanks all of you who participated in this process by responding to the survey and attending the Supplier Forums. A representative list of forum participants is in Appendix F. Without your input, this initiative would not have been possible. CSA looks forward to continuing to work with all stakeholders to address identified common requirements and enable a successful global 21st century aerospace supply network.

Sincerely,

Christine M. Purcell  
Manager, Industry Workforce  
and Manufacturing Development  
California Space Authority

## EXECUTIVE SUMMARY

### Background

As the world moves into the 21st century, unprecedented global access to information, resources, and transportation has transformed the competitive marketplace and “flattened” the world<sup>1</sup>. Economies that are globally competitive are those that have robust local ecosystems of resources that support innovation and productivity. A vital part of any such ecosystem is an educated workforce with the necessary skills to stay competitive. In this rapidly transforming world, these ecosystems must provide support for continuous learning and for the ongoing creation of new ideas and skills. With this insight, and with the support of the Department of Labor’s Workforce Innovation in Regional Economic Development (WIRED) grant, the California Space Authority’s (CSA), and their many partners, addressed three strategic goals: Innovation and Entrepreneurship Development; Supply Chain Competitiveness and Industrial Rejuvenation; and Talent Development for both emerging and incumbent workers, including Science, Technology, Engineering and Math (STEM), Career Technical Education (CTE), and global supply chain and integrated manufacturing skills. This report focuses primarily on the Supply Chain Competitiveness and Manufacturing Rejuvenation (also referred to as the Smart Supplier Initiative and Supplier Transformation Strategy) research and subsequent projects. With up to 80% of final product content and innovation coming from the supply base, requirements for both supplier company capability and workforce have changed, requiring integrated life cycle systems support, and the ability to compete in global complex dynamics supplier networks rather than static vertical chains.

### Characterization of California Aerospace Supply Chain Capabilities

Under the Industrial Rejuvenation and Supply Chain Transformation goal, CSA commissioned the 21st Century Supply Chain Transformation Survey, which was developed by Antelope Valley College with input from CSA and its members, prime contractors, multi-tier contractors, government entities, professional associations, workforce development boards and educational partners. The survey is essentially a compilation of prime and agency first level supplier assessments, which follows the product development life cycle from requirements through support, and aligns with the SAE International Americas Aerospace Quality Group’s (AAQG) Capabilities Maturity Model (CMM). This report quantifies and analyzes the results of the 21st Century Supply Chain Transformation Survey and the qualitative data gathered through industry forums and from the CSA WIRED Supply Chain Industry Advisory Group (SCIAG). (Appendix B: Members of Industry Advisory Committees: California Space Industrial Base Vitality (CSIBV) Space Manufacturing Group (SMG), Supply Chain Industry Advisory Group (SCIAG))

A total of 288 respondents took the survey, representing the views of corporations at all levels of the supply chain. The data revealed that 67% of respondents consider supply chain integration an issue that negatively affects profits and quality. While 50% of the respondents have interdisciplinary capabilities; collaboration occurs less than 25% of the time up and down the supply chain, indicating the potential for additional opportunity for tighter integration and interdisciplinary collaboration. Better communication and a shared understanding among California

manufacturers about the current state of the aerospace supply chain needs to happen before true collaboration and transformation can take place.

The data gathered in the 21st Century Supply Chain Transformation Survey indicated that the larger the company, the worse the description of the current state of the supply chain. Close to 40% of the small companies—companies with fewer than 100 employees—described the current state of integration as “Efficient,” while fewer than 20% of the large companies—those with 1,000 employees or more—described the current state of integration the same way. Far more of the large companies described the current state of integration as something that “Negatively Affects” their company. Though not a direct outcome of the research, this may be due to the larger companies having greater visibility of the total supply chain and having overall responsibility for system integration. Among respondents that selected “Needs some improvement”, the majority of respondents cited communication and flowdown issues as areas of highest concern.

Adoption of supply chain technologies such as Exostar and RFID (Radio Frequency Identification) varied among survey respondents and may be due to a perceived lack of benefits, expense, security and evolving standards. Stated supplier selection criteria was “Best Value”, for the majority of companies, with “Price and Capacity” listed as a second priority. On time delivery to customers was the highest rated supply chain metric, and inventory turns the lowest priority. Lean Manufacturing was the most widely adopted improvement process and value mapping had the highest degree of variation relative to company size. Most companies indicated that they always managed suppliers; however, variation ranged from more than 70% by large companies to roughly 40% by other

<sup>1</sup> Friedman, Thomas L. *The World Is Flat: A Brief History of the Twenty-First Century* Farrar, Straus, Giroux. New York. 2005.

companies, with 70% of large companies jointly resolving supplier problems, and roughly 50% of other companies resolving problems collaboratively. Common communication of performance and quality indicators varied greatly by size of company.

## Perceived Needs

Survey respondents were asked to select the top three issues of most importance to their company's success in the next three years. Across the board, "Lowering Production Costs" ranked as most important to success. "Product Innovation" ranked as least important. Only the large companies ranked supply chain integration in the top three issues. This parallels the data in which the majority of larger companies described the current state of supply chain integration as something that negatively affects their company. Running a close second behind "Lowering Production Costs", was a "Highly Trained Workforce". When asked, "Where do you anticipate a shortage of employees to occur within your company in the next five years?" respondents overwhelmingly selected skilled production, and scientists and engineers, with small companies placing greater emphasis on skilled production workers and large companies on scientists and engineers. Improved supply chain integration practices may be related to lowering costs, as could an effective workforce and increased appropriate innovation.

The highest training investment was made in the areas of (a) basic skills and (b) ongoing upgrade of technology skills with companies developing and/or delivering 50–100% of training in house. In addition to basic entry skills and technology skills, common capabilities requirements fell into four major areas: Logistics/Transportation, Functional Best Practices, Modeling and Space-specific Technology Training. When asked about potential interest in training in these areas, there was definitive evidence of interest, primarily among smaller companies, for training in supply chain Functional Best Practices.

## Training and Workforce Development Priorities

Training priorities include Supply Chain Management and Functional Best Practices, Basic Skills and ongoing Technology training. Potential adoption of a statewide standard applied technology skills assessment and certification process may help the technical

skills workforce development problems. A supply chain management overview seminar, which addresses supply chain principles in a global environment, supply chain relationships and structure including working in a global, dynamic, complex system, regulation, cross-functional systems engineering basics, and project management basics, is being developed under the WIRED program. Though not funded as part of the WIRED program, this seminar could be developed into a full California Community College (CCC) Supply Chain Management certification program, which could be made available throughout the CCC system. The WIRED Supply Chain Seminar will be offered by Antelope Valley College in conjunction with industry co-hosts.

## Common Requirements and Contract Flowdown

In addition to the issues of a "Highly Trained Workforce" and "Lowering Production Costs" as described above, forum discussions identified balancing innovation and risk, and equitable and effective contract flowdowns as major concerns. Recommendations from industry and the Supplier Transformation Forum participants included leveraging and integrating existing efforts such as:

- The Aerospace Corporation Space Quality Improvement Council (SQIC), a non-attributive industry forum for sharing and exploiting best practices, lessons learned, and policy perspectives between customer and contractor leadership. Focus is on resolving root-cause problems at the principal subcontractor and supplier level spanning quality assurance, technical design, system engineering, test, and manufacturing. The national Space Suppliers Council (SSC) is a collaboration of suppliers addressing these issues from the suppliers' perspective. The goal is common, effective and equitable Specifications & Standards, Subcontract Management, Requirements Flowdown, Supplier Metrics & Assessments, and Contracting & Decisions.
- The NASA Quality Leadership Forum (QLF), a collaboration of NASA centers, prime contractors and suppliers focused on developing common assessments, suppliers ratings, and SCM and quality best practices.
- The SAE AAQG and International Aerospace Quality Group (IAQG) common

supplier Capabilities Maturity Model, Supply Chain Management Handbook, and updated AS 9100 standards.

- Inclusive integrated annual supplier forums open to all levels of the supply chain, such as the October 24, 2007 Supplier Transformation Forum at Raytheon in El Segundo, and the October 7, 2008 Supplier Transformation Forum at Northrop Grumman Corporation in Redondo Beach, CA, that address ongoing Prime/Supplier concerns, progress towards, and barriers to effective collaboration and innovation have proven helpful in crafting policy recommendations on regulations, incentives and standards that impact the aerospace industry.

Clear identification of common requirements and a means to develop common capabilities to meet these requirements resulting in a common talent pool would enable companies to focus more extensively on training related to the core competencies, proprietary needs, and competitive discriminators of individual companies. But, training is not enough. Survey data and forum discussions reveal an apparent disconnect between customers seeking innovation and collaboration, but doing business based on cost and delivery. Recently published reports complement our findings relative to SCM practices, workforce requirements and the importance of innovation:

- Forging New Partnerships: How to Thrive in Today's Global Value Chain, The Manufacturing Institute, National Association of Manufacturers and RSM MCGladrey, Inc., 2007.
- Innovation Measurement, Tracking the State of Innovation in the American Economy, a report to the Secretary of Commerce by the Advisory Committee on Measuring Innovation in the 21st century Economy, January 2008.

Suppliers are faced with trade restrictions, high costs of raw materials, quality control challenges, workforce challenges, and hard to beat bidding scenarios, which often do not provide for effective collaboration or appropriate contract flowdowns. Ultimately, the current level of integration and communication within the supply chain needs improvement before California aerospace manufacturing companies can achieve the needed transformation to be competitive in the 21st century global market. Now, more than ever, suppliers need to innovate, collaborate and work for change to promote success in the 21st century.



## The Global Supply Chain and Its Implications for California

As the world moves into the 21st century, unprecedented global access to information, resources, and transportation has transformed the competitive marketplace and “flattened” the world<sup>2</sup>. Economies that are globally competitive are those that have robust local ecosystems of resources that support innovation and productivity. A vital part of any such ecosystem is an educated workforce with the necessary skills to stay competitive. In this rapidly changing world, these ecosystems must provide support for continuous learning and for the ongoing creation of new ideas and skills.

With more than 3.5 million manufacturing jobs lost in the United States over the past decade and a half, the current need to increase global competitiveness is significant. The California manufacturing sector constituted 13% of the national decline during that period. The impact of the manufacturing supplier network on the California economy is huge in terms of both jobs and revenue. For example, a single large manufacturer has 6,000 California companies as suppliers to which it provides revenues of \$5.6B annually, affecting 60,000 jobs. In addition, according to the California Space Enterprise Strategic Plan 2007–2010, the national aerospace supply chain is critical to the state with 50% of all U.S. aerospace suppliers based in California and many of these companies are small, with 80% of the aerospace workforce employed in companies with fewer than 100 employees.

To stay competitive, California aerospace and related industry suppliers must integrate themselves into complex, dynamic, global supply networks. They must be aware of the entire prime product development cycle, how their products and processes fit into it, and how they can potentially improve overall product cost and quality. Suppliers must be knowledgeable about digitally integrated systems, such as engineering, quality and virtual prototyping. They need to provide innovative solutions, including products, technology and processes. They need to continuously improve their capabilities, reduce costs, improve delivery times, and develop/obtain workforce talent that can contribute to complex manufacturing processes and compete against low-cost alternatives.

In January 2006, Governor Arnold Schwarzenegger submitted to the U.S. Department of Labor the California Space Authority (CSA) “Workforce Transformation” proposal to secure the Workforce Innovation in Regional Economic Development (WIRED) grant. As program lead, CSA became one of 13 first generation WIRED regions nationwide selected to work with the Department of Labor to assist the federal government in addressing the priorities outlined in the American Competitiveness Initiative. The California implementation of the WIRED initiative, the California Innovation Corridor, focuses on a contiguous portion of the state where high-tech and

space enterprise assets are abundant. The California Innovation Corridor runs from Alameda County in the north to San Diego in the south and to the Inland Empire and Antelope Valley in the east. The corridor represents a burgeoning network of 13 counties and more than 60 participants focused on heralding innovation. The California Innovation Corridor is more than a geographic region—it is a living organism, a coalition built on collaboration, a region among 39 others nationally that piece by piece is addressing the puzzle of what makes innovation work for businesses, schools, R&D labs, workforce agencies, and government organizations.

This report focuses on one of the California Innovation Corridor’s three goals, Industrial Rejuvenation (Table 1). Because the role of the successful global supplier has changed from “build to print” to potentially including engineering, design, test, manufacturability and full production, often with 99.9% on time delivery and quality requirements, this goal focuses on how to quickly increase the required common core competencies of the California and U.S. supply base. This report shares the findings that have been gathered from surveys, forums and industry input focused on improving the international competitiveness of the region’s aerospace supply chain by developing and executing a Supplier Transformation strategy that supports manufacturers, small businesses and entrepreneurs in adapting to the flat world manufacturing transformation.

The vertically integrated supply chain model commonly used throughout the aerospace industry in the United States in the 20th century is evolving into a global, dynamic, complex supplier network. The supply chain transformation of the 21st century requires suppliers to go beyond Lean Manufacturing and Six Sigma implementations to improve design/engineering capability, to enhance quality assurance and to learn how to operate collaboratively. In today’s environment, primes are looking to the supply base for up to 80% of the required process and product innovation. This requires increased knowledge and capabilities on behalf of the suppliers, as well as increased collaboration, interdisciplinary integration, trust and communication throughout the entire supply base.

The goal, in support of the U.S. Department of Labor and American Competitiveness Initiative, is to assist suppliers in California in meeting the challenges imposed on them through this 21st century supply chain transformation, thereby, enhancing the global competitiveness of the supply base. The Industrial Rejuvenation project team led by the California Space Authority, worked collectively with their funded partners: Antelope Valley College, California Manufacturing Technology Consulting (CMTC), part of the Department of Commerce Manufacturing Extension Partnership (MEP), NOVA Work-

<sup>2</sup> Friedman, Thomas L. *The World Is Flat: A Brief History of the Twenty-First Century* Farrar, Straus, Giroux. New York. 2005.

force Board, and University of Southern California Viterbi School of Engineering Western Research Assistance Center (WESRAC), along with unfunded supporters including prime contractors including The Boeing Company, Lockheed Martin Company, Raytheon, Northrop Grumman Corporation; multi-tier contractors including Aerojet and ACE Clearwater; government entities including the Department of Defense, the U.S. Air Force, The Aerospace Corporation and NASA; educational partners including El Camino College and professional associations including: the Society of Manufacturing Engineers (SME) and the Supplier Excellence Alliance (SEA), and workforce investment boards (WIBs) and economic development entities (EDCs). Collaboratively, these groups worked to identify priority supplier training needs and changing training needs driven by supply chain transformation through forums and the development of a comprehensive survey. Additionally, the

survey sought to capture statistics on California’s current supply base, common requirements, and identify foundational “smart supplier” competitiveness skills.

For survey data collection, membership databases of multiple WIRED partners, aerospace membership associations and primes were used for distribution; but, we had no way to fully ensure that we would receive a representative sample of all aspects of aerospace manufacturing across the supply chain or across the state of California. Thus, while our data are valid, we cannot make inferences about core supplier capability requirements and gaps across the aerospace supply chain in California, but rather across aerospace manufacturing in California broadly. We believe that these data are suggestive of developments and trends in core supplier capability requirements and gaps and the research findings will help to optimize a California supplier development and training strategy, to help California businesses compete in the global economy.



**TABLE 1 INDUSTRIAL REJUVENATION PROJECT IN THE CONTEXT OF THE CALIFORNIA INNOVATION CORRIDOR MISSION**

**1. INNOVATION SUPPORT**

- 1.1 Creation of an Economic Development Toolkit
- 1.2 Develop 21st Century Job Profiles to define future workforce skills and needs
- 1.3 Compilation of an Innovation Asset Inventory to foster innovation and entrepreneurship
- 1.4 Support of entrepreneurial companies, including SBIR Phase II awardees, to identify best practices that lead to commercialization
- 1.5 A pilot program set to identify and replicate an existing successful model of technology transfer from a university to the business community
- 1.6 Identification of a new model for student payload rideshares on military spacecraft
- 1.7 Establish a Workforce Innovation Board (WIB) toolkit for support of entrepreneurial companies

**2. INDUSTRIAL REJUVENATION**

- 2.1 Identification of high priority supplier training needs through surveys, forums and industry input
- 2.2 Characterization of “Smart Supplier” competitiveness skills
- 2.3 Build a “Smart Supplier” resource for providers within the Corridor
- 2.4 Development of an industry-driven community college Manufacturing Technician Training Program

**3. TALENT DEVELOPMENT**

- 3.1 Compilation of a Corporation Workforce Skills Analysis
- 3.2 Unifying a Space Employer/University Consortium
- 3.3 Advancing space related experiential university internships and mentoring programs
- 3.4 Develop and execute an outreach of systems engineering training programs throughout the Corridor
- 3.5 Organize the development of a statewide STEM (Science, Technology, Engineering, Math) education collaborative action plan
- 3.6 Creation and implementation of science and math high school teachers institutes
- 3.7 Originate an industry-driven training program to retrain dislocated software specialists for space related computer science technician work
- 3.8 Orientation of university and graduate advisors to innovation-oriented acumen through the establishment of an industry mentorship link
- 3.9 Advancing the Troops To Teachers recruitment and accelerated credentialing of math/science teachers
- 3.10 Establish a model university and high school mentoring program
- 3.11 Foster a community college industrial technology-based degree in Mechatronics
- 3.12 Produce real-world curriculum for educator conferences focused on STEM education and space science
- 3.13 Develop a virtual Web-based participatory “California Space Education Center” using interactive and community building Internet technology
- 3.14 Building a Learning Collaboratory of training and best practices on innovative approaches to partnerships in support of an innovation ecosystem

## THE SURVEY AND ITS RESULTS

The 21st Century Supply Chain Transformation Survey was designed to collect information from all levels of the supply chain. The survey included questions designed to identify priority supplier training needs and changing training needs driven by supply chain transformation. The survey also sought to characterize the current supply base and common requirements, and to characterize foundational “smart supplier” competitiveness skills.

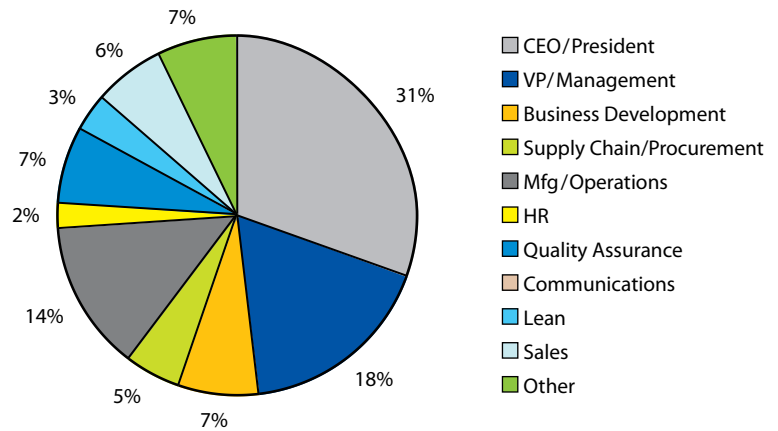
The survey was developed after extensive collaboration with CSA, primes, government agencies, CMTC, and educational partners and is based on a Capabilities Maturity Model (CMM) that addresses the product development lifecycle. Survey content was based on a compilation of first level supplier assessments currently used by several primes and agencies. Antelope Valley College designed and administered the survey as part of the California Innovation Corridor WIRED project. A copy of the survey instrument can be found at [www.InnovateCalifornia.net](http://www.InnovateCalifornia.net).

### SURVEY RESPONDENTS

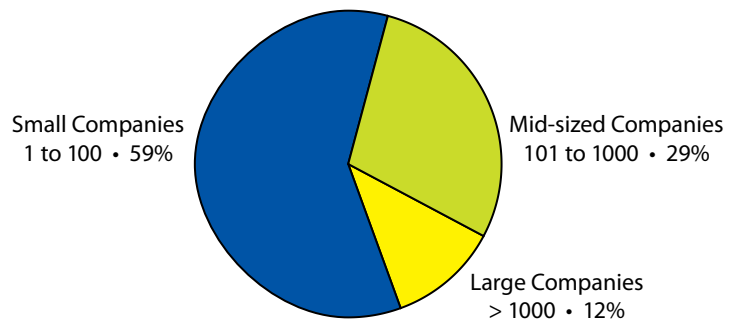
Approximately 8,000 California aerospace manufacturers were invited via e-mail to participate in the 21st Century Supply Chain Transformation Survey. The survey distribution used a spiral distribution method, e-mailed in batches by CSA, prime and multi-tier contractors, government agencies, educational entities, professional associations, and workforce and economic development entities from April 1, 2007 until it was closed September 15, 2007 with 288 responses. The overall response rate is estimated to be at least 3.6%, but because supply chain information is considered proprietary, the exact population size and response rate are unknown.

Approximately half of the 288 respondents were senior management (CEOs and vice presidents). This indicates a high level of corporate interest in the study (Figure 1), and it is consistent with the fact that 80% of the California aerospace manufacturing employees work for companies with fewer than 100 employees, i.e., CEOs and vice president often directly perform multiple functions. In addition, 29% of respondents were individuals directly involved in the supply chain implementation at the corporation (Supply Chain, Manufacturing/Operations, Quality Control, and Lean Manufacturing). For this report, companies having 1 to 100 employees were classified as small, 101 to 1,000 employees were classified as medium, and companies with more than 1,000 employees were classified as large (Figure 2).

**FIGURE 1 RESPONDENTS BY POSITION IN CORPORATION**



**FIGURE 2 NUMBER OF EMPLOYEES**  
*Company size of survey respondents*

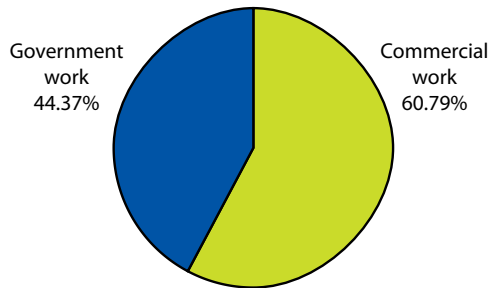
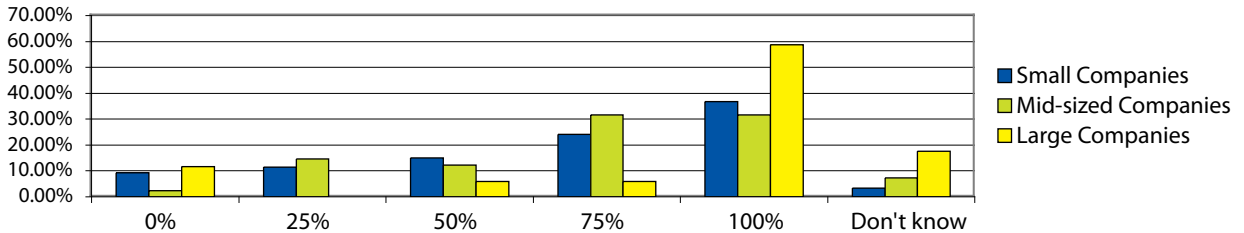


## SURVEY RESPONDENTS

Nearly 75% of respondents indicated their companies earn 50% or more of their annual revenue from aerospace (Figure 3) with a fairly even balance between government and commercial work (Figure 4).

**FIGURE 3 PERCENTAGE OF AEROSPACE SALES FOR RESPONDENTS**

*Approximately what percentage of your company revenue is sales to the Aerospace industry annually?*

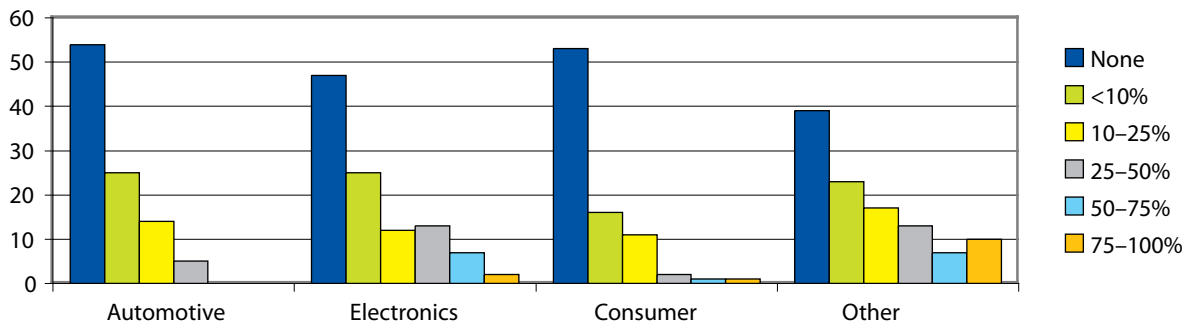


**FIGURE 4 PERCENTAGE OF WORK FOR GOVERNMENT AND COMMERCIAL**

Figure 5 and Figure 6 demonstrate that many respondents are broad-based beyond aerospace, and that California companies do significant amounts of business with other California companies of all sizes. However, when asked about their level of global interaction, 95% of small and 87% of mid-sized companies responded that they interact with less than 50 suppliers/vendors outside the United States. Large companies showed a significant drop, but showed a higher level of participation with companies outside the United States (Figure 7) than small to mid-size companies.

**FIGURE 5 OTHER MAJOR INDUSTRIES SERVED BY RESPONDENTS**

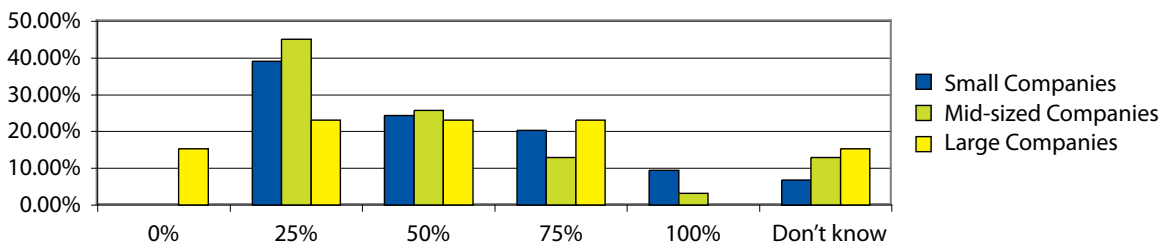
*What other major industries besides Aerospace does your company serve?*



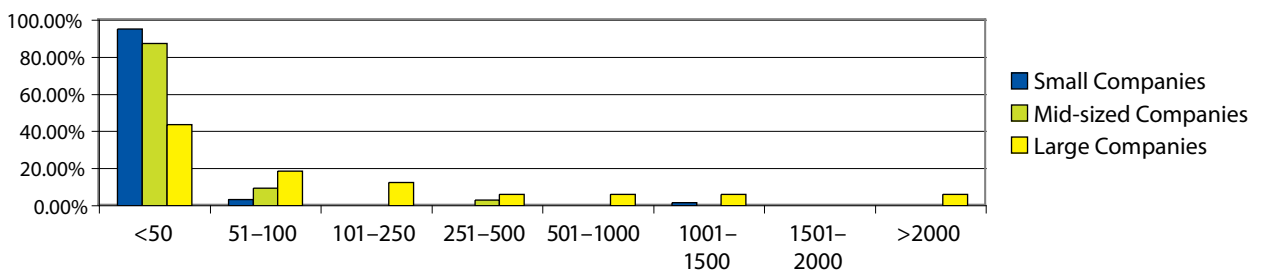


## SURVEY RESPONDENTS

**FIGURE 6** PERCENTAGE OF BUSINESS CONDUCTED WITH CUSTOMERS OR SUPPLIERS IN CALIFORNIA  
*Approximately what percentage of your company business is conducted with customers or suppliers in the state of California?*



**FIGURE 7** PERCENTAGE OF BUSINESS CONDUCTED WITH CUSTOMERS OR SUPPLIERS OUTSIDE U.S.  
*Approximately how many active suppliers/vendors does your company have globally outside the United States?*



## ANALYSIS: CURRENT SUPPLY CHAIN CAPABILITIES

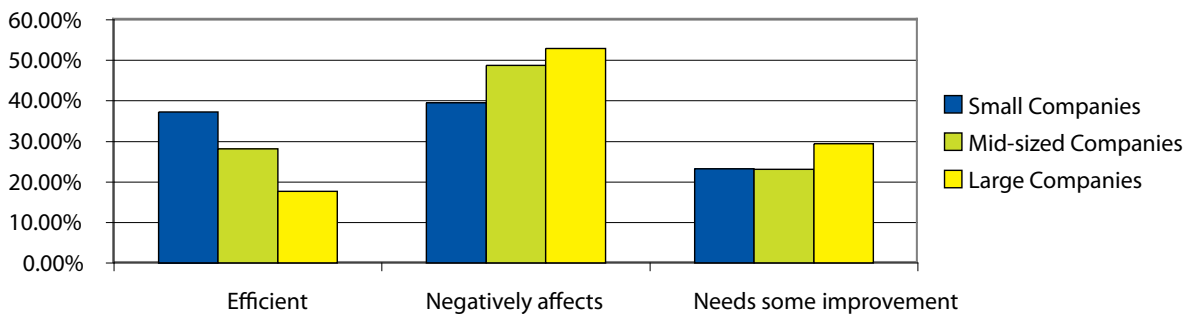
### Impact of Supply Chain Integration on Business

We turn our attention first to determining the current state of the supply chain for California manufacturing companies. In general, the larger the company, the worse the description of the current supply chain state (Figure 8). The largest response for all three sizes of corporations was “Negatively Affects,” indicating a general lack of satisfaction with the current state of the supply chain across all sizes of corporations in the survey. Close to 40% of the small companies described the current state as “Efficient,” while fewer than 20% of the

large companies described the current state as “Efficient.” Far more of the large companies described the current state of the supply chain as “Negatively Affects” than “Efficient,” while the percentages were roughly equal for small companies. These results show that the level of satisfaction with the current state of the supply chain decreases as the size of the corporation increases. Additionally, among respondents that selected “Needs some improvement,” the majority stated communication and flowdown issues as their highest areas of concern.

**FIGURE 8 DESCRIPTION OF SUPPLY CHAIN INTEGRATION WITH CUSTOMERS AND/OR SUPPLIERS**

*Please indicate the most accurate current description of supply chain integration with your company’s customers and/or suppliers:*



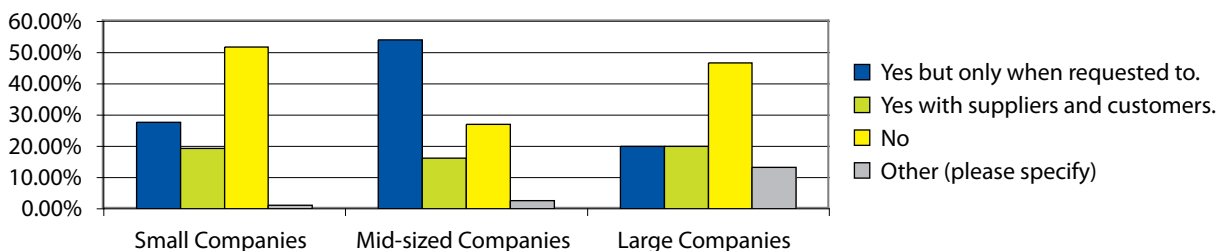
### Impact of Supply Chain Technologies

Exostar, the Aerospace and Defense Global Trading Exchange, was intended to help connect companies up and down the supply chain. For more information on Exostar go to <http://www.exostar.com/>. Its adoption, however, was highest for mid-sized companies,

primarily only when requested (Figure 9). The low use of Exostar by small (barely 50%) and large companies (less than 45%) may be due to different reasons at the different levels.

**FIGURE 9 EXOSTAR USAGE**

*Does your company use Exostar, the Aerospace & Defense Global Trading Exchange?*

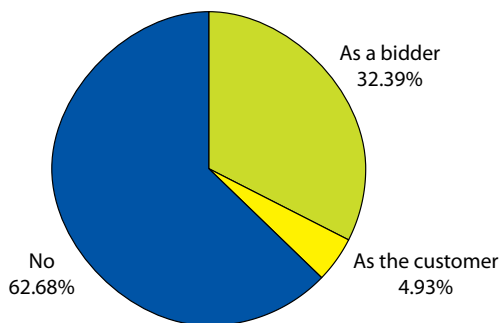


## Impact of Supply Chain Technologies

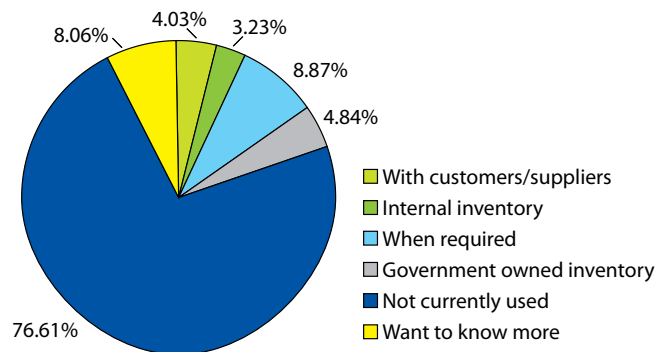
Electronic reverse auctions and RFID (Radio Frequency Identification) are other innovations that can have a major impact on cost reduction. Such instruments are intended to increase the efficiency of the supply chain, but the data indicated that neither is widely adopted (Figure 10 and Figure 11). Further research is needed to determine the root causes of suppliers' resistance to

implement RFID; however, the perception is that RFID is too expensive and too risky to implement due to lack of standards. Though not part of the quantitative data, forum discussions revealed that electronic reverse auctions can inhibit collaboration, communication and innovation that is necessary for success.

**FIGURE 10**  
PARTICIPATION IN  
ELECTRONIC REVERSE AUCTION



**FIGURE 11**  
CURRENT USE OF RFID TECHNOLOGY  
(RADIO FREQUENCY IDENTIFICATION)

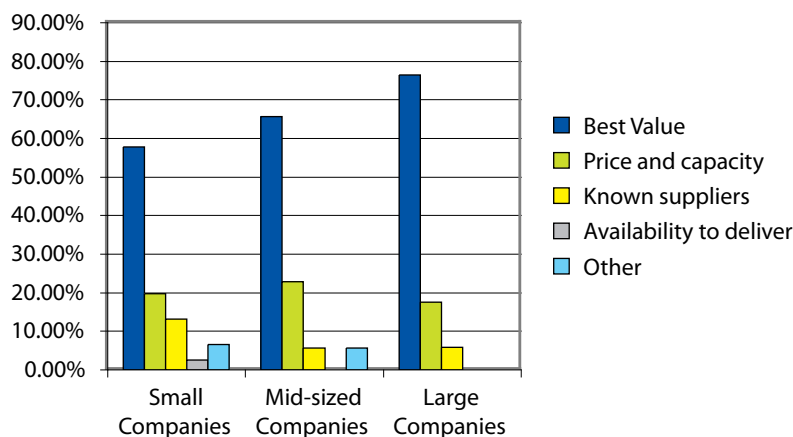


## Supplier Selection Process

When asked “What process does your company usually use to select suppliers?”, the majority of companies at all three size ranges responded that they use “Best Value” to select suppliers, with 58%, 65%, and 75% giving that response for small, mid, and large corporations, respectively (Figure 12). The second-highest response was “Price and Capacity,” at roughly 20% for all sizes of companies.

Small companies, however, responded with greater frequency than large companies that they select known suppliers over any other factors. Additionally, small and mid-sized companies stated that they used other methods as well, such as OEM (Original Equipment Manufacturers) directed procurement and selecting from approved suppliers lists.

**FIGURE 12 HOW SUPPLIERS ARE SELECTED**  
*What process does your company usually use to select suppliers?*



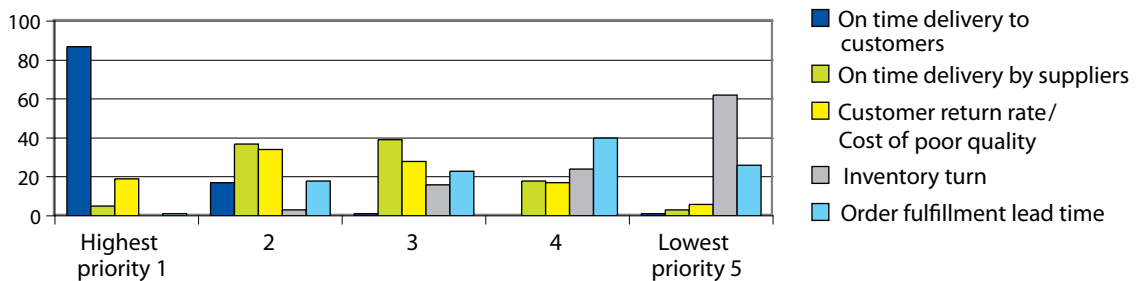
## Supply Chain Metrics

All respondents answered roughly alike when asked about their priority of supply chain metrics, selecting “On time delivery to customers” as their highest priority and “Inventory turn” as lowest priority. Other options were ranked at mid levels with slightly more importance placed on “On time delivery by suppliers” and

“Customer return rate” and slightly less on “Order fulfillment lead time” (Figure 13). As inventory turns do affect costs, and can affect delivery, the low priority given to this may suggest that the relationship is not fully understood, and that inventory is not fully optimized.

**FIGURE 13 PRIORITY OF SUPPLY CHAIN METRICS**

*Please put in rank order according to your company's priority of supply chain metrics:*

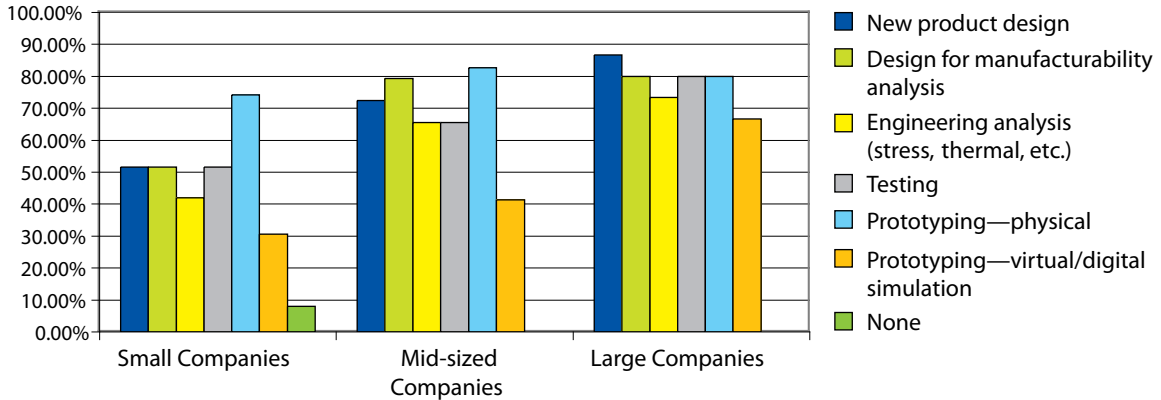


# Supplier Life Cycle Capabilities and Collaboration

In analyzing the responses about capabilities there was a disconnect between the high percentages of early phase design and test capabilities across the supply chain at nearly 50% or greater

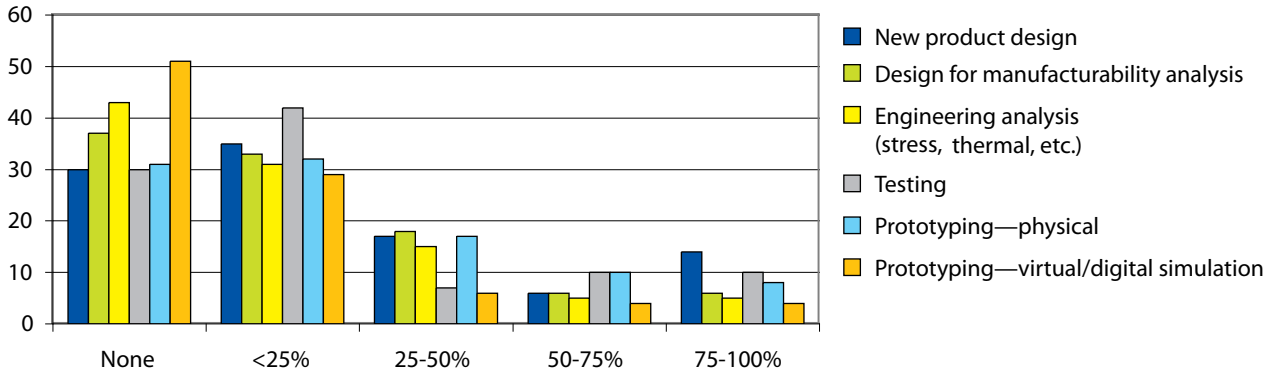
(Figure 14), and the majority of respondents stating they use these capabilities less than 25% of the time with their suppliers or customers (Figure 15 and Figure 16).

**FIGURE 14 COMPANY CAPABILITIES**  
*What capabilities exist in your company?*



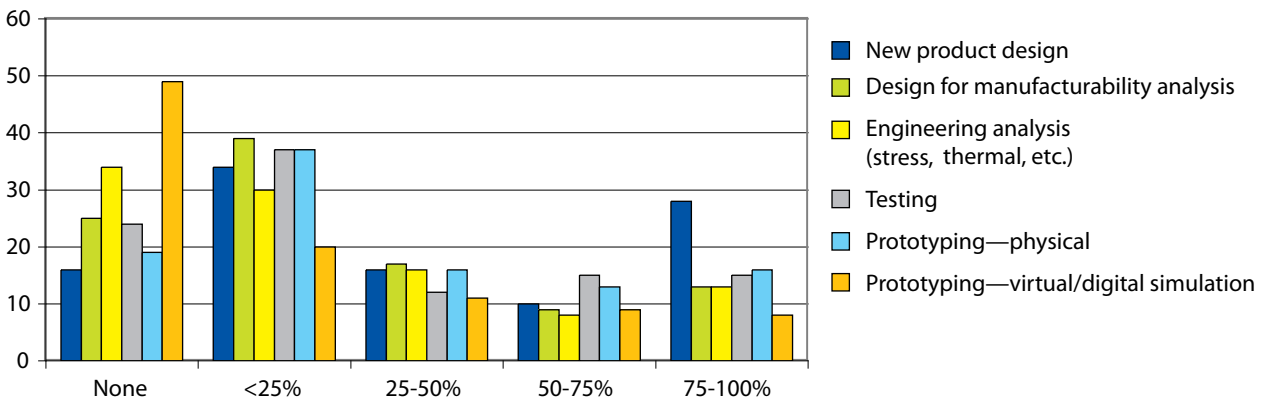
**FIGURE 15 PERCENT OF COLLABORATION WITH SUPPLIERS**

*How often does your company collaborate with suppliers in each of these functions?*



**FIGURE 16 PERCENT OF COLLABORATION WITH CUSTOMERS**

*How often does your company collaborate with customers in each of these functions?*



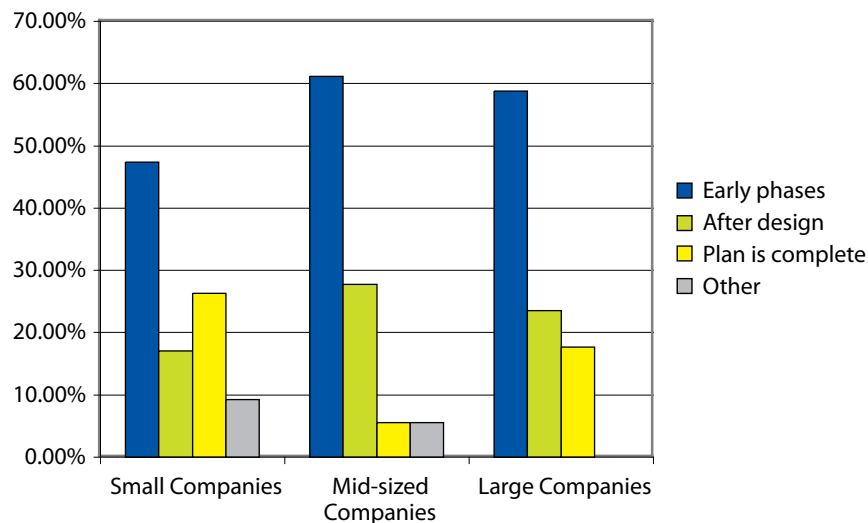
## Supplier Life Cycle Capabilities and Collaboration

The data also indicated that high percentages of all size corporations bring their suppliers into the product development cycle early (Figure 17), while smaller percentages are brought in after a plan is complete. The same was true when asked when their company is invited to participate (Figure 18). These results show

that views match across the supply chain on the point at which suppliers are brought into the process. Further study will be needed to determine if supply chain capabilities are being fully utilized and if utilization may be increased with more effective supply chain integration through collaboration and communication.

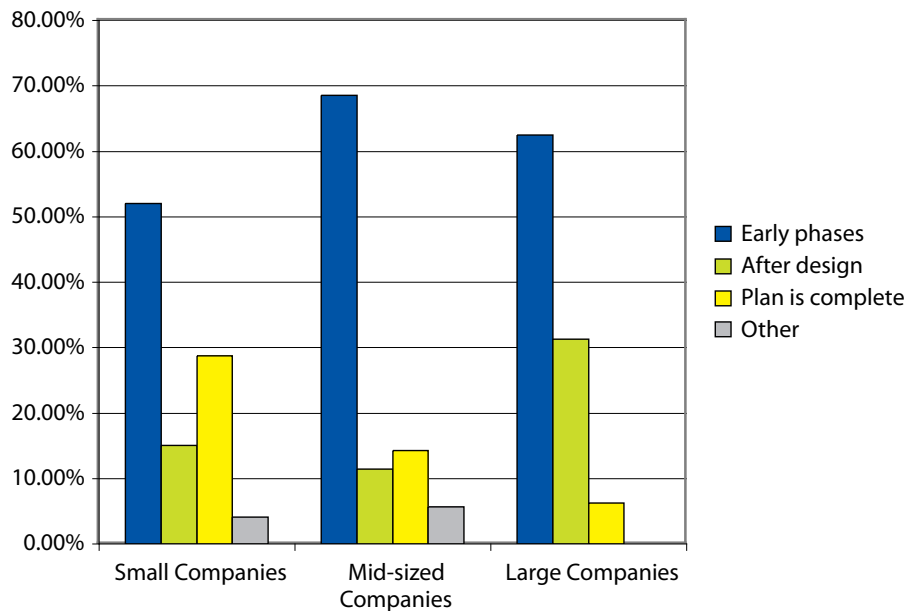
**FIGURE 17 PRODUCT DEVELOPMENT PHASE WHERE COLLABORATION OCCURS**

*At what point in your company's product development cycle does your supply chain organization and suppliers usually get involved to collaborate?*



**FIGURE 18 PRODUCT DEVELOPMENT PHASE IN WHICH CUSTOMERS INVITE COLLABORATION**

*At what point in your customer's product development cycle is your company invited to participate?*

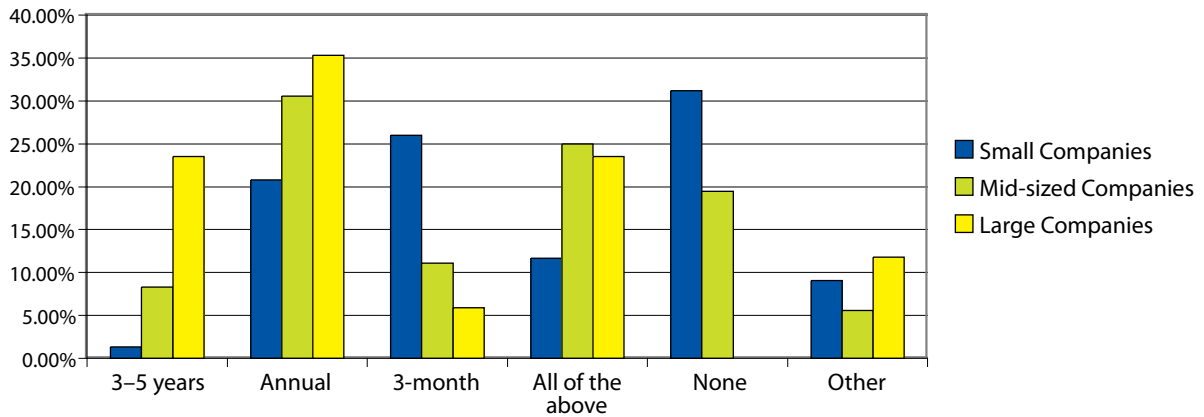


## Inventory Planning

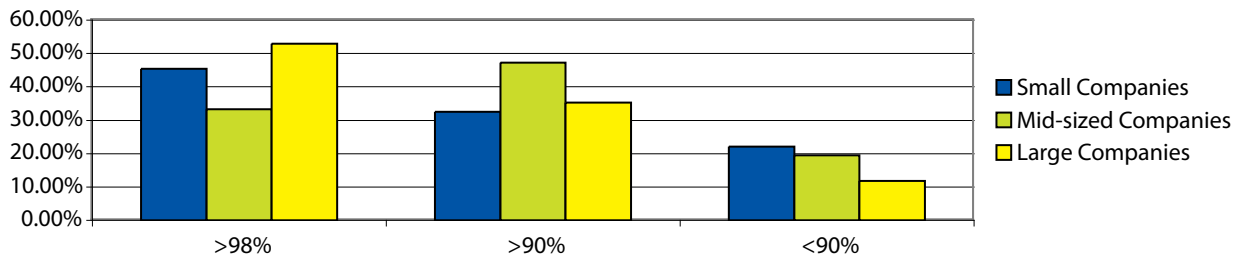
When considering longer-term planning for materials for the supply chain, the data indicated that it is primarily a function of large and mid-sized companies (Figure 19). About one-third of small companies use no planning for materials, while more than 80% of mid-sized companies and all large companies use materials planning.

Inventory accuracy levels are estimated to be more than 98% for the majority of large and small companies, while the largest percentage of mid-sized companies estimate their level of inventory control at greater than 90% (Figure 20).

**FIGURE 19 DEGREE OF SUPPLY CHAIN MATERIALS PLANNING**  
*What type of Supply Chain planning for materials does your company perform?*



**FIGURE 20 INVENTORY ACCURACY CONTROL OF RESPONDENTS**  
*Approximately how well is inventory accuracy controlled by your company?*

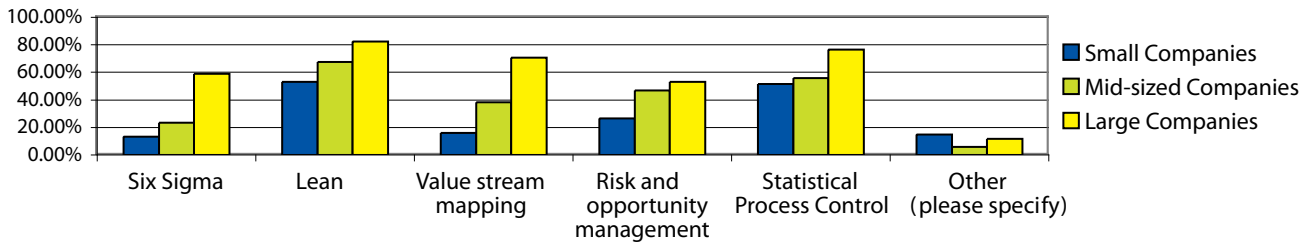


## Improvement Methodologies

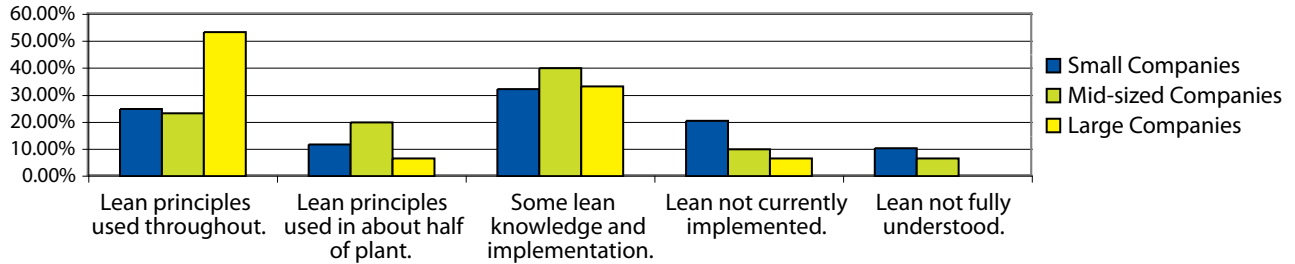
Adoption of quality improvement processes was directly related to company size for all named processes (Figure 21). Lean manufacturing was the most popular for all three size groups, with 50% of small, 65% of mid-sized, and over 80% of large companies responding positively that they are using it. The largest difference in adoption was value stream mapping, which was used by 70% of large companies and only 15% of small companies. Responses

indicated that the extent of lean principles adoption was much higher for large companies with more than 50% using it throughout manufacturing areas (Figure 22). The survey results also show that Six Sigma and Lean have been used for a longer period of time in large companies, with the vast majority answering “>2 years,” while only 60% of the mid-sized companies and fewer than 40% of the small companies have used them more than two years (Figure 23).

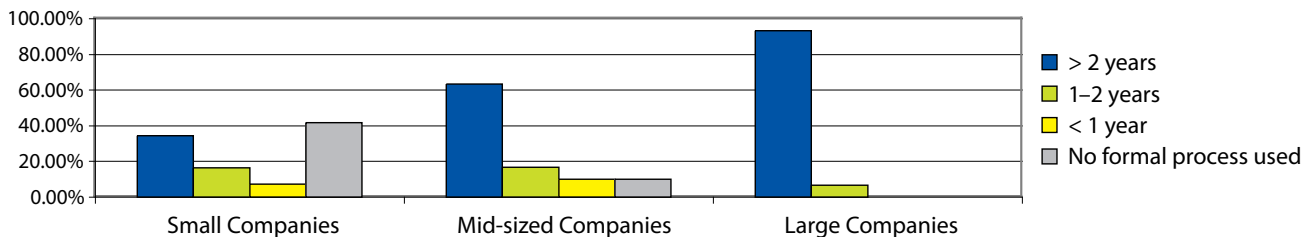
**FIGURE 21 IMPROVEMENT PROCESSES USED**  
*What improvement processes are used by your company?*



**FIGURE 22 USE OF LEAN PRINCIPLES**  
*How much of lean principles are used by your company in manufacturing areas?*



**FIGURE 23 TIME USING LEAN**  
*Approximately how long has your company used a continuous improvement method such as Six Sigma or Lean?*



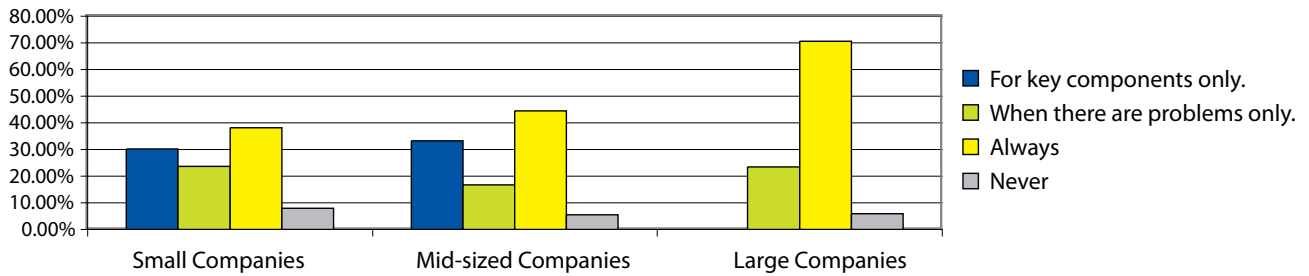
## Supplier Management

When asked if their company manages their suppliers, most companies indicated they “Always” manage suppliers. For large companies, the figure was greater than 70% with more than 60%

of the large companies indicating that they “work together” or share routinely with their suppliers. These ratios drop for medium and small companies (Figure 24 and Figure 25).

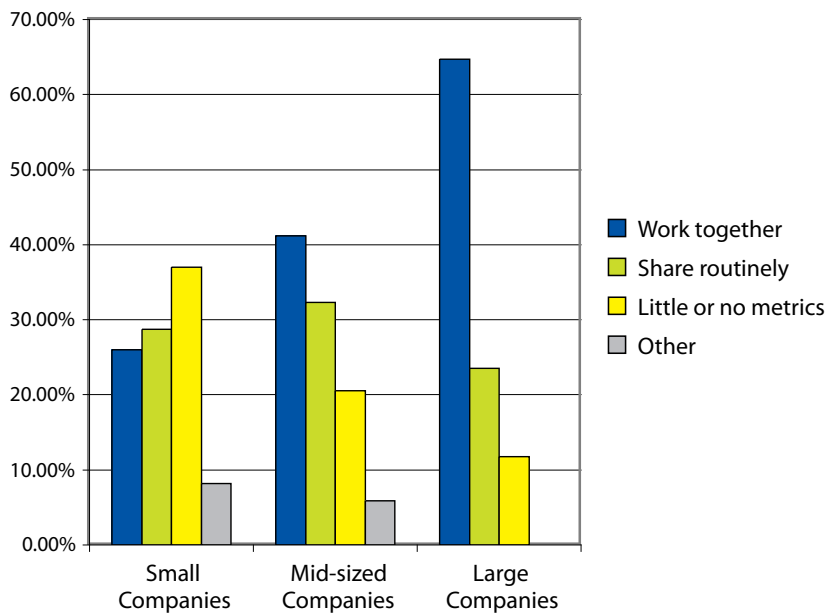
**FIGURE 24 LEVEL OF COMPANY MANAGEMENT OF SUPPLIERS**

*Does your company manage suppliers?*



**FIGURE 25 HOW SUPPLIERS ARE MANAGED**

*If so, how are suppliers managed by your company?*

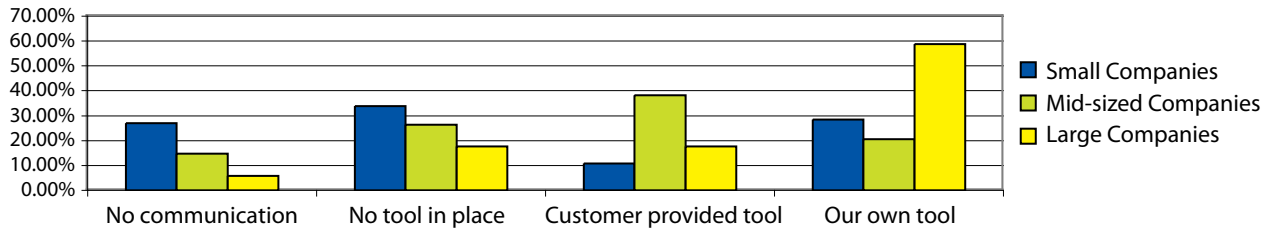


# Quality Management

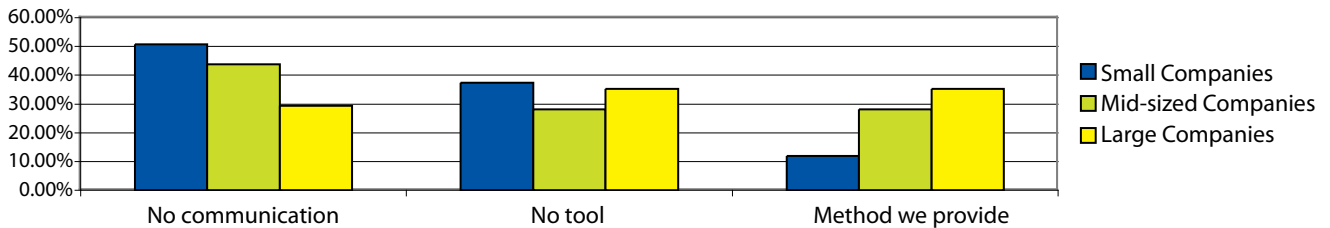
Almost 60% of larger companies use their own tool to communicate quality metrics to their customers, a rate considerably higher than that for small and mid-sized companies. Mid-sized companies tended to use a customer-provided tool to communicate quality metrics, while small companies had no specific tool or no communication (Figure 26). As company size increased, the percentage that use their own tool for quality communication to their suppliers increased (Figure 27). High percentages of small and mid-sized companies responded they do not use a specific tool to communicate performance and quality metrics to their suppliers.

Over 90% of the large companies resolve supplier quality problems by working together with their suppliers. Roughly 50% of the small and mid-sized companies resolve problems by working together with their suppliers, while 30% to 40% of the small and mid-sized companies resolve problems independently (Figure 28). Overall, the data indicates that there is an inconsistency in how and to what degree quality metrics are captured and communicated, suggesting a potential need for standard quality metrics flowdown to all levels of the supply chain.

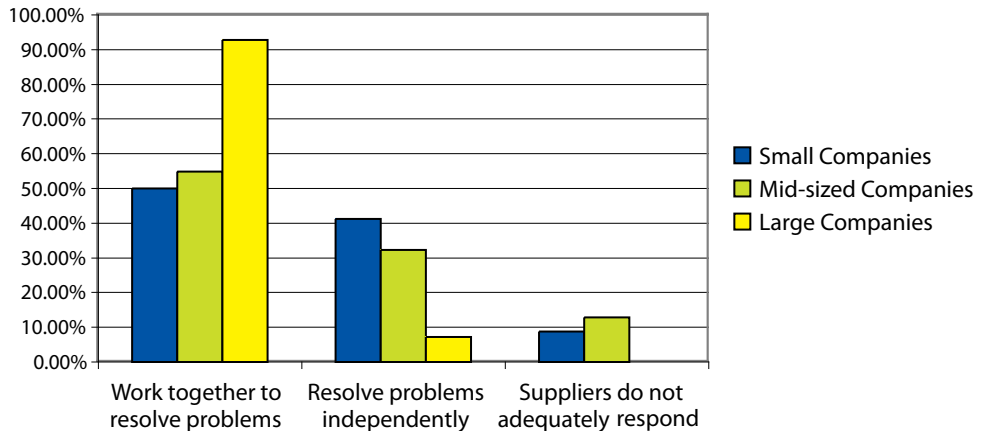
**FIGURE 26 COMMUNICATION OF PERFORMANCE AND QUALITY METRICS TO CUSTOMERS**  
*Does your company use a specific tool to periodically communicate performance and quality metrics to your customers?*



**FIGURE 27 SUPPLIER COMMUNICATION OF PERFORMANCE AND QUALITY METRICS**  
*Do your suppliers use a specific tool to periodically communicate performance and quality metrics to your company?*



**FIGURE 28 RESOLUTION OF SUPPLIER QUALITY ISSUES**  
*How does your company manage supplier quality issues?*



## PERCEIVED NEEDS

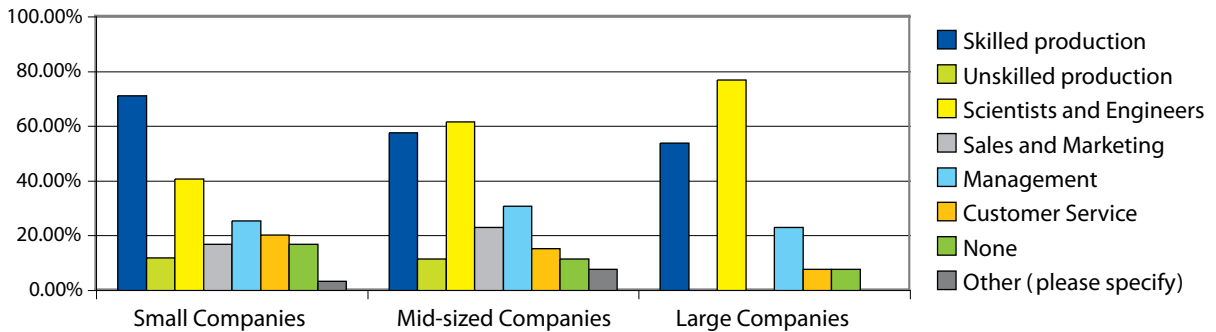
### Workforce Shortages

The survey also addressed labor supply and training needs. When asked, “Where do you anticipate a shortage of employees to occur within your company in the next five years?” respondents overwhelmingly selected skilled production workers and scientists

and engineers (Figure 29). Small companies placed greater emphasis on skilled production workers, while large companies placed the emphasis on scientists and engineers. Management was third on the list across all company sizes, followed by customer service.

**FIGURE 29 PERCEIVED FIVE-YEAR EMPLOYEE SHORTAGES**

*Where do you anticipate a shortage of employees to occur within your company in the next five years?*

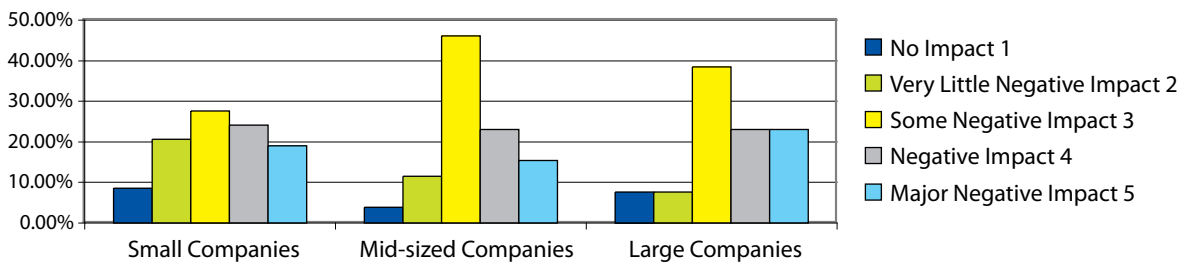


Additionally, when asked, “At what level does the shortage of skilled employees affect your company’s ability to meet customer needs?” more than three-quarters responded that it had some negative

impact, and over 18% of those stated that the shortage of skilled employees has a major negative impact on their respective company’s ability to meet customer needs (Figure 30).

**FIGURE 30 PERCEIVED IMPACT OF SKILLED EMPLOYEE SHORTAGE**

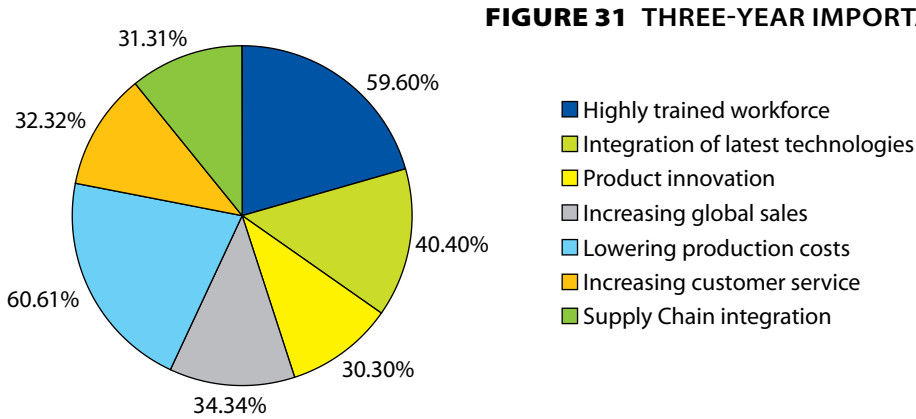
*At what level does the shortage of skilled employees affect your company’s ability to meet customer needs?*



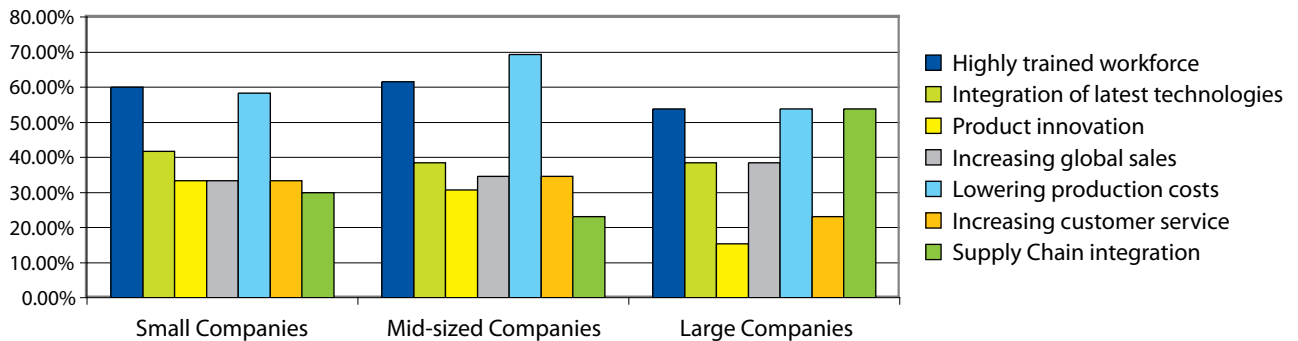
## Top Three Success Factors

Survey respondents were asked to select the top three issues that are the most important to their company's success in the next three years. Across the board, all companies said, "Lowering Production Costs" ranks as most important to success and "Product Innovation" ranks as least important (Figure 31). This data is in slight contrast to the 2005 Skills Gap Report conducted by the National Association of Manufacturers. Of the 800 manufacturing businesses surveyed by NAM, three-fourths of respondents cited a "highly trained workforce" as key to future business success and ranked "new product innovation" as second<sup>3</sup>. In breaking apart the data, small companies did rank a highly trained workforce as the most important issue. Product innovation, however, did not make the list of the top three issues. Large companies ranked both a highly trained workforce and lowering production costs at the

top of the list, and they ranked product innovation significantly at the bottom. Medium-sized companies aligned more closely with small companies and ranked workforce training a close second after lowering production costs with innovation somewhere in the middle. However, only the large companies ranked supply chain integration in the top three, which may be due to their increased visibility of the entire supply chain. Both small and mid-sized companies rank integration of latest technologies as the third most important factor to their company's success in the next three years (Figure 32). It is worth mentioning that studies have shown that supply chain integration does have an effect on the highly rated issues, including production costs, technology integration and workforce requirements<sup>4</sup>.



**FIGURE 32 THREE-YEAR IMPORTANCE**  
*Which of the following are the most important to your company's success in the next three years?*



<sup>3</sup> National Association of Manufacturers and Deloitte Development LLC, 2005 Skills Gap Report—A Survey of the American Workforce, 2005, available at <http://www.nam.org/2005skillsgap>

<sup>4</sup> Report of the Interagency Working Group on Manufacturing R&D Committee on Technology National Science and Technology Council, March 2008, Manufacturing the Future—Federal Priorities for Manufacturing Research and Development available at [http://www.manufacturing.gov/pdf/NSTCIWGMFGRD\\_March2008\\_Report.pdf](http://www.manufacturing.gov/pdf/NSTCIWGMFGRD_March2008_Report.pdf)



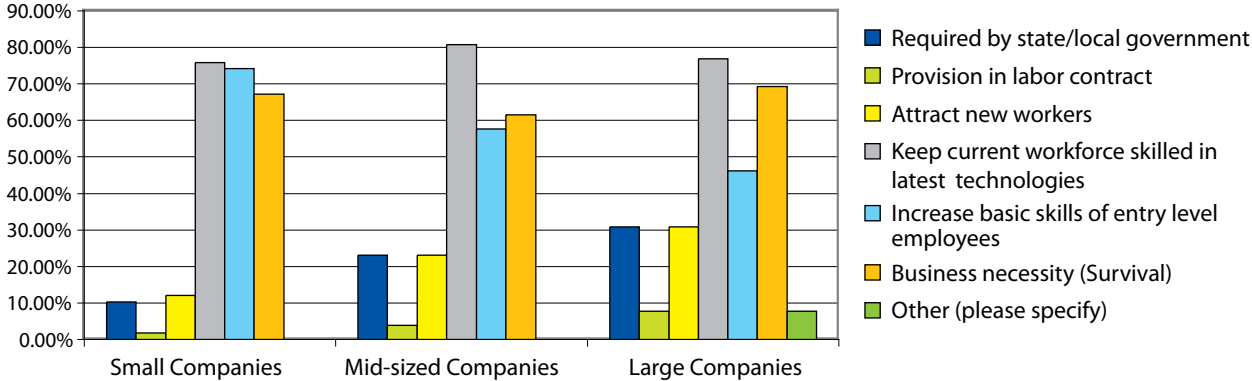
**TRAINING**  
**Priorities**

The need to keep current workers skilled in the latest technologies and to increase the skill level of entry-level employees were two of

the top three reasons that companies at all three size groups gave for providing training (Figure 33).

**FIGURE 33 REASONS FOR OFFERING TRAINING**

*What are the predominate reasons your company provides training to your employees currently?*



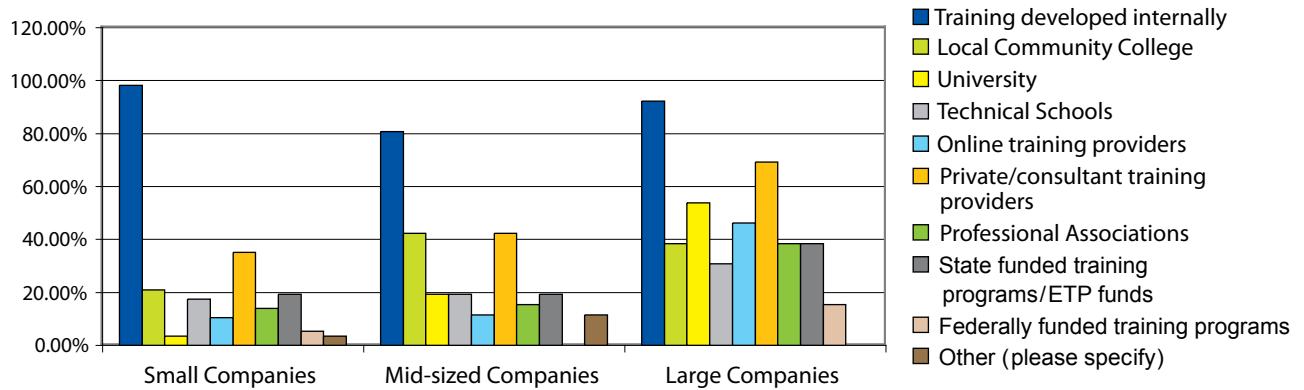
## Sources

When asked “How does your company currently meet training needs?”, “Training developed internally” was the single most common answer for companies, with over 80% of mid-size companies, over 90% of large companies, and almost 100% of small companies indicating that they use internally developed training (Figure 34). Additionally, over 95% of respondents who indicated basic skills and technology skills as the predominate reasons their company provides training also indicated that they develop training internally. This suggests that there may be duplication of effort in training development that could be diminished through utilization of common resources to provide these types of trainings.

Universities were used as a source of training at higher levels for

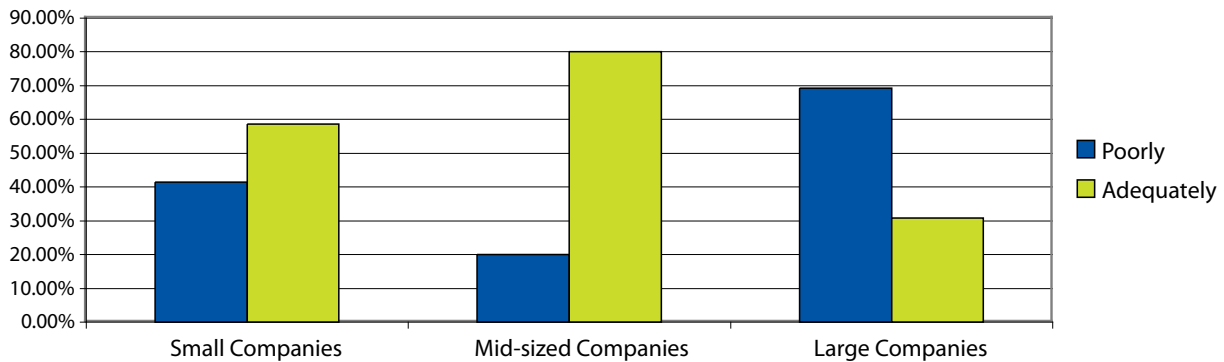
larger companies (less than 10% for small companies, 20% for mid-sized companies, and over 50% for large companies). Community colleges were used to meet the training needs of about 20% of the small companies, and about 40% of the mid- and large-sized companies. Although no respondents indicated that applicants with community college certificates are fully prepared for positions in their company, 80% of mid-sized and nearly 60% of small companies are satisfied with graduates of community college degree and certificate programs. However, there is a continuous need for California community colleges to update their programs to align with the rapidly changing needs of state and local industry (Figure 35).

**FIGURE 34 CURRENT TRAINING DELIVERY**  
*How does your company currently meet training needs?*



**FIGURE 35 PREPARATION LEVELS**

*How prepared for an entry-level job with your company are applicants with a certificate from a community college?*



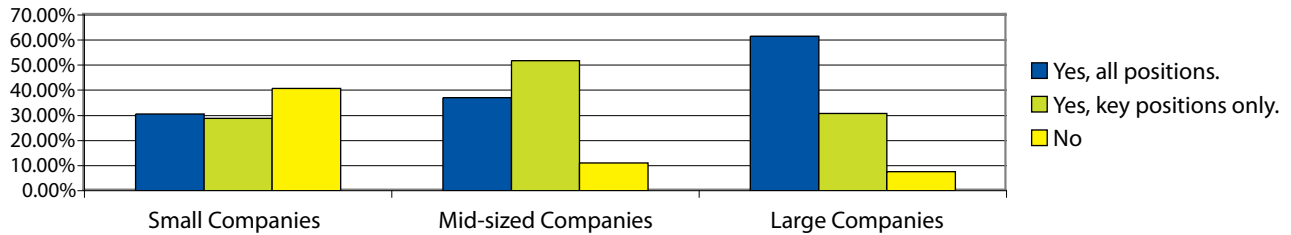
## Workforce Development Practices

More than 60% of the large corporations that responded to the survey indicated that they had workforce development plans with defined skill requirements, assessment, gap analysis and training for all positions (Figure 36). An additional 30% have it for key positions. Roughly, 50% of mid-sized companies said they have programs

in place for key positions, almost 40% have plans for all positions, and 10% of mid-sized companies have no plans. Fully 40% of small companies have no plans, while roughly 30% have plans for all positions or key positions. This may suggest a potential need for Human Capital Development planning training for small companies.

**FIGURE 36 WORKFORCE DEVELOPMENT PLAN**

**Does your company have a workforce development plan that has defined skill requirements, assessment, gaps analysis, and training for all positions?**

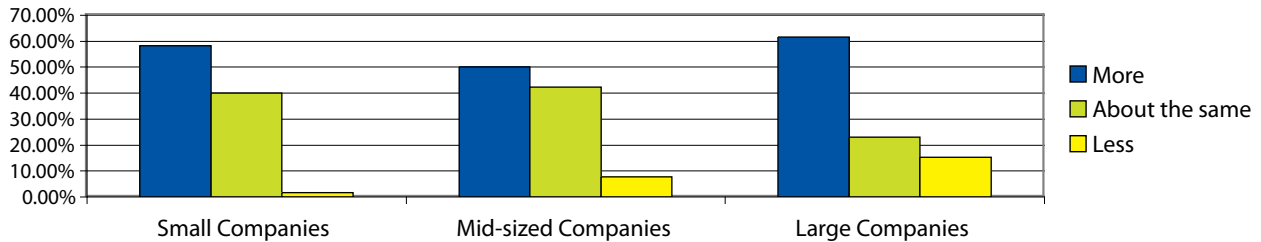


Survey data showed that over 50% of the California's aerospace manufacturers are spending more now on training than they did in previous years (Figure 37). This may be due in part to the high percentage of respondents that are developing training internally and

the fact that respondents indicated more than half of their employees are trained annually (Figure 38). Additionally, a lack of entry-level skills and ongoing advances in technology are factors that may be influencing this increase in spending.

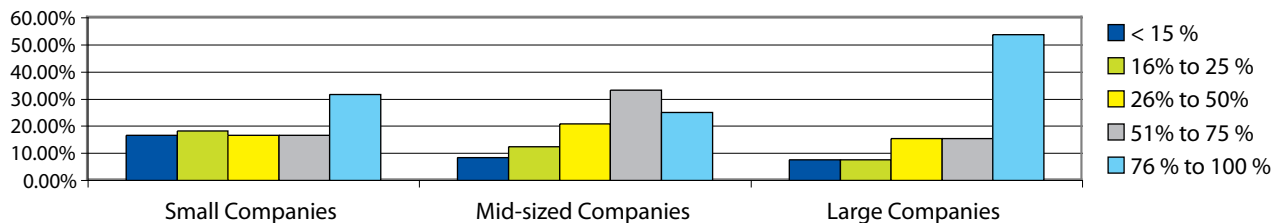
**FIGURE 37 CHANGE IN TRAINING EXPENDITURES**

**Does your company spend more, less or about the same on training as it did five years ago?**



**FIGURE 38 PERCENT OF EMPLOYEES GIVEN TRAINING EACH YEAR**

**Approximately what percent of your employees receive training provided by your company each year?**





## Training Areas

The final sections of the survey involved general areas of training needs and sought to identify potential training needs that could be used for development of training programs. The lists of training areas were developed after extensive input from multiple primes and industry partners as to what training areas currently are needed in the California aerospace supply chain.

The training areas surveyed were broken down into two sets:

Indicate how important training in the following areas is for your company in the next three years:

- Logistics and Transportation Best Practices
- Purchasing and Procurement Best Practices
- Manufacturing Best Practices
- Finance and Accounting Management Best Practices
- Sales and Marketing Best Practices
- Information Technology Best Practices
- Forecasting and Time Series Analysis
- Engineering Modeling and Testing
- Design Modeling
- Crimping, Cabling, and Harnessing

Indicate how important training in the following space related areas is for your company in the next three years:

- Designing Systems for Space Radiation Environments
- Initial General Space Hardware Training
- Launch Vehicle Environments, Loads and Testing
- Performance, Reliability, Redundancy for Space Products
- Remote Sensing for Earth Science Applications
- Space Environment - Implications for Spacecraft Design
- Space Environment and Spacecraft Environmental Hazards
- Space Systems Fundamentals
- Space Vehicle Mechanisms: Elements of Successful Design
- Spacecraft Connector Mate and Demate
- Spacecraft Thermal Control

Principal components analysis (Principal Components Analysis, G.H. Dunteman, Sage University Press, 1989) was used to group the training areas by how the companies answered on level of importance. Four groupings were identified within the two sets of training areas (Table 2).

**TABLE 2 TRAINING AREAS GROUPED BY SHARED LEVEL OF IMPORTANCE**

<b>LOGISTICS AND TRANSPORTATION BEST PRACTICES</b>	
<p><b>FUNCTIONAL BEST PRACTICES</b></p> <ul style="list-style-type: none"> <li>• Purchasing and Procurement</li> <li>• Manufacturing</li> <li>• Finance and Accounting Management</li> <li>• Sales and Marketing</li> <li>• Information Technology</li> </ul>	<p><b>MODELING</b></p> <ul style="list-style-type: none"> <li>• Forecasting and Time Series Analysis</li> <li>• Engineering Modeling and Testing</li> <li>• Design Modeling</li> </ul>
<p><b>SPACE-SPECIFIC TECHNOLOGY</b></p> <ul style="list-style-type: none"> <li>• Crimping, Cabling, and Harnessing (not part of the space-related training questions)</li> <li>• Designing Systems for Space Radiation Environments</li> <li>• Initial General Space Hardware Training</li> <li>• Launch Vehicle Environments, Loads and Testing</li> <li>• Performance, Reliability, Redundancy for Space Products</li> <li>• Remote Sensing for Earth Science Applications</li> <li>• Space Environment—Implications for Spacecraft Design</li> <li>• Space Environment and Spacecraft Environmental Hazards</li> <li>• Space Systems Fundamentals</li> <li>• Space Vehicle Mechanisms: Elements of Successful Design</li> <li>• Spacecraft Connector Mate and Demate</li> <li>• Spacecraft Thermal Control</li> </ul>	

This shows that needs for training on logistics and transportation were independent of the other needs. Companies interested in purchasing and procurement training were also likely to express a need for training in the rest of the Functional Best Practices group. Companies expressing an interest for forecasting and time series analysis were also likely to express an interest for the other Modeling group training areas. Companies interested in crimping, cabling and harnessing training (not part of the space-related training questions) were also likely to express an interest in all of the space-related training

areas. These results can be used to guide development of training programs, where classes offered in the areas within the color groupings are likely to attract interest as a consistent program. While Logistics and Transportation best practices training were not grouped with other training areas, it would be a good course to offer with any of the other three because of its broad applicability. Additional training areas suggested by respondents may indicate a need for additional research on a common applied technology assessment process with relative specific skills training (Table 3).

**TABLE 3 ADDITIONAL AREAS OF TRAINING SUGGESTED BY RESPONDENTS**

Systems engineering	Multi-axis lathe operation	High speed machining
Root cause analysis	and programming	Change management
Advanced machining	Supplier management	Blueprint reading
Electronics	Geometric tolerancing	Electrical engineering
Six Sigma	Automation	Material development
Thermal design	Materials engineering	Safety
	Lean	Parts inspection

## SUPPLIER TRANSFORMATION FORUM

On October 24, 2007, CSA held the Suppliers Transformation Annual Forum at the Raytheon Event Center in El Segundo, California. The event attracted 200 attendees, consisting of more than 100 aerospace suppliers (Appendix F). The forum was open to all California aerospace suppliers, and suppliers were integrated into the planning of the forum agenda. A copy of the agenda can be found at [www.InnovateCalifornia.net](http://www.InnovateCalifornia.net). The day's agenda addressed four areas: Requirements, Realities, Successful Transformations, and Resources. Forum topics focused on dealing with challenges and solutions facing aerospace manufacturers and their relationships with subcontracting companies in the 21st century.

Dr. Wanda Austin, President, The Aerospace Corporation, delivered the keynote address and encouraged the audience to remember that the forum was transformative and a positive step

toward changes needed to keep the industry globally competitive in the 21st century.

Industry successes in transformation between primes and suppliers were highlighted by representatives from major manufacturers including Raytheon, Lockheed Martin Corporation, The Boeing Company, Northrop Grumman Corporation, and Aerojet working with subcontractors such as Cristek Interconnects, Inc., Intrinsyx, HITCO, and Saalex Solutions. Other panel discussions included companies such as ACE Clearwater and Qual-Pro, who offered frank observations on the formula for success, industry challenges faced, and resources available. Complete capture of the Supplier Transformation Forum, including individual speaker and session videos, slides and bios can be accessed at [www.InnovateCalifornia.net](http://www.InnovateCalifornia.net).



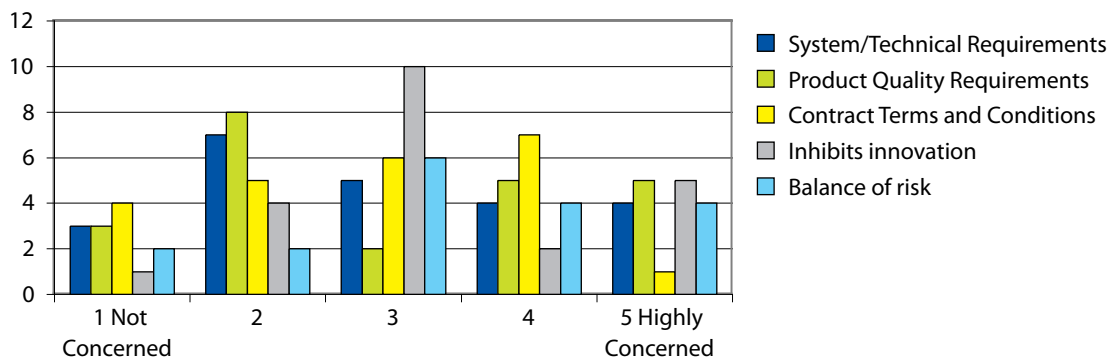
### Forum Follow-up Survey

At the forum, a follow-up survey to the 21st Century Supply Chain Survey was distributed. A copy of the survey instrument can be found at [www.InnovateCalifornia.net](http://www.InnovateCalifornia.net). The data collected confirmed the results from the 21st Century Supply Chain Survey with a few important additions. Forum discussions indicated that reverse auctions did not facilitate open collaboration and cooperation; and that lowest price often determined who won the bid (Figure 10). Based on the analysis of the 21st Century Supply Chain Survey data, we wanted to find out more about how troublesome different types of flowdown issues were to the supply chain. The results showed that opinions on

this matter varied significantly from company to company; however, all five areas were fairly balanced in the number of responses rating them as an area of concern with a slight difference in the areas of "Contract Terms and Conditions" and "Inhibits Innovation" (Figure 39). Overwhelmingly, "Inhibits Innovation" was selected as a moderate area of concern, which is important to note since product innovation was ranked as least important to success by the 21st Century Supply Chain Survey respondents (Figure 32). This is a concern as historically U.S. GNP has been driven by innovation.

**FIGURE 39 RATE OF FLOWDOWN CONCERN**

*Please rate each type of flowdown as to how troublesome it is on a scale of 1–5, with 5 being the highest degree of concern.*



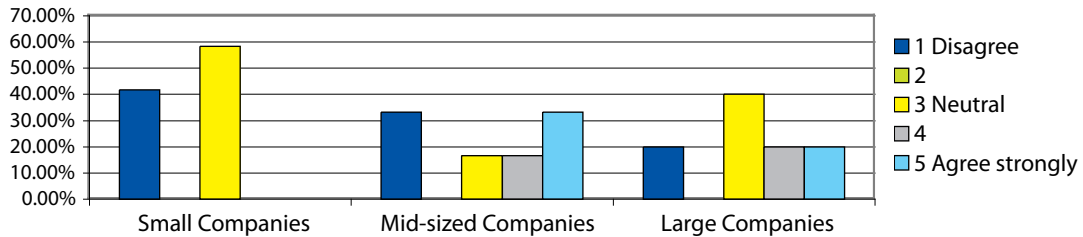


ITAR (International Traffic in Arms Regulations), a set of U.S. government regulations that control the export and import of defense-related articles and services in the *United States Munitions List*, was another area we wanted to look at in detail. Supplier Transformation Forum Participants were asked if they agreed with the following statement: “ITAR (International Traffic in Arms Regulations) negatively affects my ability to compete globally.” Small companies responded neutrally or disagreed with the statement.

Mid-sized companies were divided in their response, but a greater percentage agreed or agreed strongly than respondents from large companies (Figure 40). It may be that mid-size companies are most affected because large companies have staff focused on ITAR compliance, and the slowdown may not directly impact the small companies, or this could be attributed to a lack of awareness of ITAR regulations on the part of the small companies.

**FIGURE 40 EFFECTS OF ITAR ON COMPETING GLOBALLY**

**ITAR (International Traffic in Arms Regulation) negatively affects my ability to compete globally.**

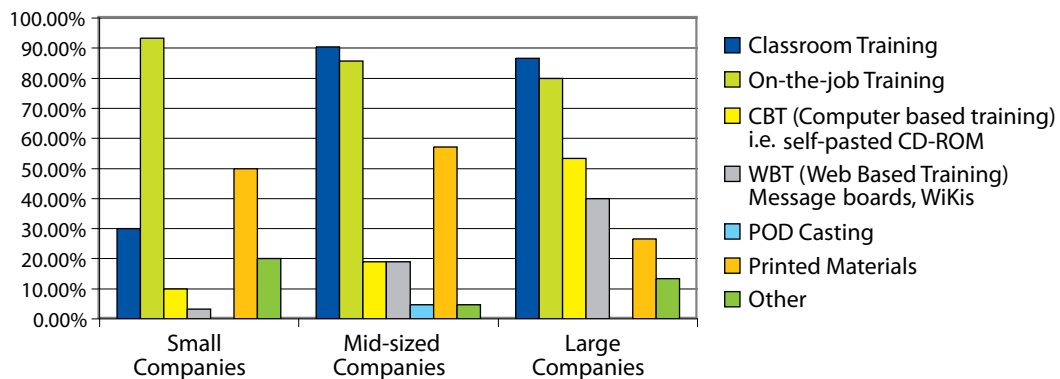


Additional information was also gathered about the methods used to deliver training to employees. All companies predominately used “On-the-job Training” (OTJ) with “Classroom Training” being utilized slightly more so among mid- and large-sized companies (Figure 41). Nearly 20% of mid-sized companies and 40% to 50% of large companies are utilizing Computer Based Training (CBT) and Web Based Training (WBT); however, CBT is being used by only

10% of small companies and WBT by just over 3%. The added costs in developing classroom trainings, CBT and WBT programs may explain the lack of use in smaller companies. As the data showed in the 21st Century Supply Chain Survey the vast majority, over 98%, of smaller companies develop their trainings internally with few exceptions (Figure 34).

**FIGURE 41 TRAINING METHODS**

**What are the predominate methods your company uses to provide training to your employees?**



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## CONCLUSIONS AND RECOMMENDATIONS

Increased collaboration and open communication are necessary to function and enable innovation in complex, dynamic, global systems. Training, policy, practices, and appropriate incentives are needed to facilitate the collaboration and communication required to enable innovation. Though the benefits of greater levels of integration within the supply chain are understood by some, common understanding by all nodes of the supply chain is necessary for improvement. The incentives to spend money on staff, training, technology, and process development are not adequately addressed in the cost-driven competition of the global economy. Low-cost, easily accessible training of employees, particularly entry-level employees, is a growing concern of corporations at all levels of the

supply chain. Peter Drucker, a management and quality pioneer, predicted that future workers will still be called upon to engage in manual tasks, but their jobs will also require a “substantial amount of theoretical knowledge which can only be acquired through formal education, not through an apprenticeship.”<sup>5</sup> The California economy has benefited significantly from the low-cost, high-quality education provided by the California Community College system, the California State University system, and the University of California system. This public education infrastructure can continue to play a key role in assuring that California’s manufacturing sector is a major source of employment and economic activity.

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### Conclusion:

A common approach and common resources to address training needs would be beneficial, perhaps even with a common assessment process for applied technology skills. With the overwhelming majority of respondents stating they develop training internally, there is indeed a role for the statewide educational and training entities and industry to support aerospace supplier transformation training priorities.

- Small companies ranked a highly trained workforce as most important to their company’s success in the next three years.
- Small percentage of companies with fewer than 100 employees currently utilize community colleges to meet training needs.
- Supply chain Functional Best Practice—engineering, quality, business, human resources, finance, sales and marketing, information technology combined with logistics/transportation is a targeted area of interest for small companies.

### Recommendation

#### (Training Areas):

Utilize low-cost training options delivered through traditional and emerging alternative methods to best meet the specific needs of the local industry. Small to mid-size companies would be the best initial target market for

training in supply chain and logistics since they currently have the most interest and need.

Increased understanding of supply chain, systems, product life cycle and functional best practices are required in order to enable the globally competitive performance of suppliers. Additionally, it is recommended that training be enhanced or developed to address consistent, reliable basic skills development in the areas of Applied Reading, Applied Math, Applied Information and Applied Technology, with an interdisciplinary approach focused on problem solving and industry context. More specialized design capabilities training such as modeling—forecasting, engineering, etc. and space-specific technologies will be better utilized once changes are made throughout the industry that support innovation and design, and truly incentivized best value more consistently or greater than the current system of rewarding lowest costs and on-time delivery.

### Recommendation

#### (Integration of Workforce Development, Training and Industry Relevancy):

There is a need for tighter integration of industry with education to create the workforce required by suppliers to compete

globally in the 21st century. There is also a need for increased contextual learning combining technical, workplace scenario, systems and problem solving capabilities. Addressing common basic skills through common training resources will create a “known” common talent pool for industry to draw from, reducing redundancy of companies developing and providing similar common training and allowing companies to focus on very specific skills training relative to proprietary knowledge and discriminators.

- Establish a statewide career readiness assessment and certification (CRC) process that aligns with national efforts of the National Association of Manufacturers Manufacturing Institute workforce development efforts and the Department of Labor Advanced Manufacturing Competency model. This should include integrated basic and technical interdisciplinary skills including mechanical, electrical, fluid and thermal engineering basics in a contextual problem solving way that will enable companies to better predict job performance and streamline training resources and efforts. The current Career Readiness Certificate program can be considered for this, currently adopted statewide by many other

<sup>5</sup> Peter Drucker, The Next Society, The Economist, Nov, 1 2001.

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## CONCLUSIONS AND RECOMMENDATIONS

states with significant manufacturing, with eight separate regional initiatives in California, and the basis for the National Association of Manufacturers Manufacturing Institute efforts towards common fundamental skills certification; details at [www.BusinessAssist.org](http://www.BusinessAssist.org).

- Review California Employment Training Panel (ETP) to enable increased flexibility to include more integrated work/study. Integrating formal training, mentoring and experiential training, including On the Job (OTJ) training, and an integration of basic skills training using technical content is necessary in a global 24/7 economy. This includes training delivery via a variety of methods and integrated work/study programs, which partner education institutions with industry, decreasing the time to productivity for the workforce. For information on ETP funding, please go to <http://www.etp.ca.gov/>.
- Implement I-BEST (Integrated Basic Education and Skills Training). Increase integrated basic skills, workplace scenarios and technical content training programs to reduce the time to complete and to increase relevancy and retention. The state of Washington (<http://flightline.highline.edu/ibest/>) has increased retention (from 70% to 100%) and performance (from 1.7 to 3.2 GPA) of community college programs through integrated rather than serial programs, using technical content and workplace scenarios to teach basic skills.
- Establish an Industry in Residence program to increase relevancy, open to all levels of intersegmental education. Relevancy appears to have a major effect on education effectiveness and retention rates. Many companies employ a rotational human capital development program, integrating experiential (with defined business objectives), formal

training and mentoring as a best practice. Consider a program to incentivize industry to include one rotation as service to a school district or educational institution—for a single semester at 80% of their time, at full salary paid for by their company. These individuals would not get credentialed, but would be an educational enhancement to the school districts or educational institutions to which they are assigned. Activities could include anything from hands-on experiments to teacher in-service training to community college certificate program development and delivery, to school or evening family/community assemblies, to standards review and input to a systems engineering project for interdisciplinary university students. The industry individual and company would gain valuable communications experience, while providing relevancy on a continual basis to the educational system. Teachers who participate would receive professional development credit. Criteria, results dissemination and metrics would need to be established for incentives to be realized. Please refer to the Policy, Practices, Standards, and Incentives recommendation below for more detail.

### Conclusion:

Training is not enough. Through survey data and forum discussions, it is apparent that there is a disconnect between customers seeking innovation, but doing business based on cost and delivery. As the data showed, innovation was viewed as least important to success. Information gathered over the last year indicates that at the current time, the level of integration within the supply chain is in need of improvement. The data illustrates that the primary factors used in selecting suppliers are cost and on-time delivery, though best value is cited as the strategic driver.

### Disconnections in Current State of the Supply Chain

- Large companies indicate that integration affects them negatively *and* small companies indicate that integration is efficient.
- All companies say “Lowering Production Costs” ranks as most important to success *and* “Product Innovation” ranks as least important.
- There are more suppliers with early design phase capabilities *than* suppliers using those capabilities with their customers and supply chains.
- Innovation is an area of concern among members of the supply chain, *but* it is over-powered by other flowdown issues that relate to costs, quality, technology and risk.

### Recommendation

#### (Policy, Practices, Standards, and Incentives):

There is a critical need for a core change in practice, starting with the customer, to facilitate a true and total transformation of the aerospace supply chain in California. This change needs to come with a primary focus on developing a balance between risk and innovation, consistent balanced contract flowdown and standard supply chain practices that will support a common destiny of success for all nodes of the supply chain.

- **Standardize common supplier assessment process and SCM practices:** Common supplier assessment processes and requirements among major industry customers including agencies and prime contractors will increase overall efficiencies and quality, and reduce assessment costs for both primes/agencies and suppliers. Alignment of The Aerospace Corporation Space Quality Improvement Council (SCIC) and National Space Suppliers Council (SSC), the NASA Quality Leadership forum (QLF) and

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## CONCLUSIONS AND RECOMMENDATIONS

SAE International Americana and international Aerospace Quality Groups (AAQG/IAQG) efforts can help achieve this. Refinement of the CSA WIRED Supplier Transformation Survey from an anonymous survey into an online assessment directly tied to the AAQG Capabilities Maturity Model (CMM) and Supply Chain Management Handbook (SCMH), as well other resources can help facilitate and actualize these efforts.

- **Balance risk and reward; balance risk and innovation:** Review and reform of current contract flowdown processes and incentives to better reflect current supply chain structure and responsibilities, through integrated SCIC, SSC, QJF and AAQG efforts, perhaps facilitated by CSA. Determination of common innovation measures and value may facilitate faster innovation implementation and risk mitigation.

- **Accelerate finalization of an RFID global aerospace standard.** RFID can have a major impact on cost reduction through business process streamlining, supply chain collaboration, rapid availability of business data, higher level of granularity in business intelligence, refined inventory management including perishable components, better accounting and financing of assets, global visibility into distributed collaborative enterprises, product life cycle management, operations management, and enhanced infrastructure management.
- **Consider a Human Capital Development Tax Credit similar to the R&D Investment Tax Credit tied to a common industry relevancy based integrated workforce development program, such as an Industry in Residence Education program:** Establish criteria including relevancy, sustainability with continued involvement

by industry, standards review, best practices consolidation and dissemination, and metrics. Criteria and dissemination of findings could be performed by CSA. This would leverage industry investment in education and industry relevancy professional development to teachers. The incentive would be realized after the results are achieved. This may have little effect on actual costs to the state but would leverage industry investment and provide ongoing relevancy to education.

- **California Collaborative System:** Create a shared California innovation collaboration system among government, universities and industry to enable companies to innovate using high performance computing and tools to design manufacturing processes which in turn shortens the development process and reduces the amount of physical testing.

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## Related inter-agency and industry association findings relative to U.S. manufacturing competitiveness

The findings outlined in this California Innovation Corridor report are consistent with reports recently published by the U.S. Department of Commerce, which stress the value of innovation, integrated intelligent manufacturing and innovative manufacturing processes including nanotechnology as imperative for continued U.S. global competitiveness. These reports can be found by visiting:

- **Innovation Measurement**, advising the measurement and value of innovation: <http://www.innovationmetrics.gov/Innovation%20Measurement%2001-08%20rev%20040908.pdf>
- **Manufacturing for the Future**, where integrated, intelligent manufacturing, as well as hydrogen energy and nano-manufacturing are key: [http://www.manufacturing.gov/pdf/NSTCIWGMFGRD\\_March2008\\_Report.pdf](http://www.manufacturing.gov/pdf/NSTCIWGMFGRD_March2008_Report.pdf).

The Manufacturing Institute of the National Association of Manufacturers (NAM) has also produced a recent report with complementary findings and resources for small and medium manufacturers, *Forging New Partnerships: How to Thrive in Today's Global Value Chain*, [http://www.nam.org/s\\_nam/bin.asp?CID=216&DID=239787&DOC=FILE.PDF](http://www.nam.org/s_nam/bin.asp?CID=216&DID=239787&DOC=FILE.PDF). An important related finding was that 60% of small manufacturers and 40% of medium manufacturers do not have a defined New Product Development and Introduction (NPDI) process, often with any innovation being managed by a single person, rather than throughout the organization's functions, suggesting that NPDI could be an area of curriculum focus and mentoring to better develop this capability, so that small and medium manufacturers understand this process—both how it applies internally and as part of their supply network.

## CSA NEXT STEPS

California Space Authority (CSA) is a nonprofit, industry-driven, membership-based corporation that represents California's aerospace businesses that support commercial, civil, and national security needs. CSA and these survey results support the U.S. Department of Labor Workforce Innovation in Regional Economic Development (WIRED) California Innovation Corridor competitive initiative to help develop the aerospace and related high technology industry capability in California. Additional information about CSA and the DOL WIRED initiative can be found at [www.CaliforniaSpaceAuthority.org](http://www.CaliforniaSpaceAuthority.org).

**CSA served as project lead on all deliverables discussed in this section, additional WIRED programs related to supply chain produced the following deliverables:**

- Manufacturing Technician Certificate with El Camino College—including composites structures technology.
- Mechatronics Certification with Allen Hancock College.
- Interdisciplinary Innovation Model with University of California, Riverside and Stanford University—private/public university internships; finding that successful innovation requires early collaboration between customer and innovator, sharing of risks, costs, requirements, increased need for interdisciplinary, project based and problem solving abilities.
- 21st Century Advanced Mfg. Technician Occupation Definition—discrete, process, nano, in partnership with several workforce and economic development partners.
- Systems Engineering Curriculum and Outreach, in partnership with The Aerospace Corporation
- 21st Century Industry Skills Assessment, in partnership with several workforce and economic development partners.

**Desired Next Steps that require additional funding include:**

### Training, Education and Workforce Development

- Design, pilot and implement an “Industry in Residence” program, which requires sustained onsite education enhancement by an industry professional; consider a Human Capital Development tax incentive. This program would have criteria designed to leverage investment by industry in education and training environments.
- Develop, pilot and implement a statewide applied technology career readiness assessment certification process and hands-on learning lab for high wage high tech industries, including space.
- Design, develop and implement a Supplier Resources Center to include assessment, training and access to high performance computing and tools for optimizing product development.
- Develop, pilot and implement an Employment Training Panel (ETP)-approved integrated training model to include formal training, mentoring and experiential training integrated with basic skills with technical content.

### SCM Common Best Practices, Policy

- Common Online Supplier Assessment and Resources Enhancement
  - Redesign and deploy the survey as an assessment, make it available and integrated online with the SAE International AAQG CMM, integrate the WIRED Supply Chain Resources Directory online with the SCMH and integrate it with the assessment.
  - Incorporate a voluntary supplier database with assessment ratings.
  - Integration of NASA Quality Leadership Forum (QLF) & DOD Supplier Quality Improvement Council (SQIC), national Space Suppliers Council (SSC) efforts, standards and practices.
  - Incorporate Interdisciplinary Innovation Study findings into the Supplier

Assessment and investigate innovation measurements specific to supply chain and incorporate into the assessment.

- Conduct a global pilot with a mid tier supplier on developing a global supply chain strategy using 21st century marketing and communication strategies.
- Continue the Annual Supplier Transformation Forum—as updates to initiatives to address gaps.
- Conduct a pilot of a digital x-ray inspection program that will meet qualifications—physical x-ray inspection is a great expense to small companies though many primes still require physical x-ray inspection. This is costly and very “un-green”.
- Develop a SCM targeted New Product Development and Implementation Process course and assessment—this will enforce life cycle, system design and support principles, and innovation development. This addresses the fact that most small manufacturing companies do not have a defined process to address innovation, product development and introduction.



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## AVC WIRED DELIVERABLES AND NEXT STEPS

Antelope Valley College is a comprehensive community college established in 1929, serving more than 15,500 students in the heart of California's "Aerospace Valley." The college recognizes that it is uniquely capable of responding to the requirements of regional business, industry, and public service, as well as the social and cultural needs of the Antelope Valley. Antelope Valley College is dedicated to meeting the dynamic needs of a changing community. The college addresses the educational needs of a diverse and evolving population and is dedicated to providing services to a broad range of students with a variety of educational goals. For more information about Antelope Valley College, go to [www.avc.edu](http://www.avc.edu).

As a partner with CSA in the Industrial Rejuvenation project of the Department of Labors WIRED Grant, Antelope Valley

College aided in the identification of high priority supplier training needs through surveys, forums and industry input. In this effort, AVC worked with CSA and industry partners to develop the 21st Century Supply Chain Transformation Survey, provided distribution management and was responsible for data analysis and publishing the data results. As a direct result of the data gather AVC has created the Introduction to 21st Century Supply Chain Management Seminar based on the outcomes that address supply chain and logistics management, to meet the increasing interest and demand for high-caliber professionals in the aerospace supply chain and logistics fields.



Future projects that may stem from this project could include the transformation of Supply Chain Management Seminar into a full California Community College (CCC) Supply Chain Management certification program, available throughout the CCC system; and, the placement of the Introduction to 21st Century Supply Chain Management Seminar on the Web for participants and others to access. It is also possible the seminar could be linked with WESRAC's proposed Second Life Supply Chain Campus. In addition, AVC's Business and Computer Studies Division, through a Career Technical Education Grant, is developing an education pathway that will reach into local middle schools and high schools to inform and encourage students to pursue careers in supply chain management and logistics.



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..... DELIVERABLES AND NEXT STEPS .....

### CMTC WIRED DELIVERABLES AND NEXT STEPS

CMTC's Aerospace & Defense Group provides professional management consulting services to assist manufacturers in achieving and sustaining world-class performance. Our consultants average more than 25 years of industry experience and provide hands-on implementation assistance and training to support our clients' competitive growth strategies. CMTC is the nation's largest member of the National Institute of Standards & Technology (NIST) Manufacturing Extension Partnership (MEP) whose mission is to strengthen U.S. manufacturing global competitiveness. We assist our clients in transformations to a Lean enterprise, supply chain management, industry specified quality standards, IT selection and implementation, business process improvements, change management and workforce & organizational development to address the core issues facing primes and suppliers.

#### CMTC—Pilot Supplier Assessment Program

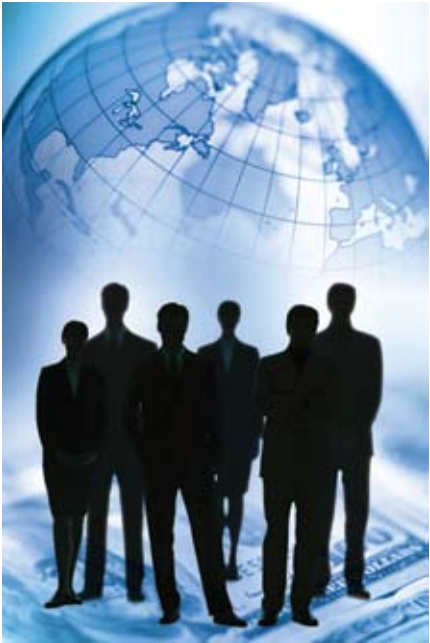
CMTC has leveraged the WIRED Supplier Transformation survey, a supply chain management assessment, and a benchmarking tool with the DOD Mentor Protégé program, in the development and transformation of Omega Precision to become a key supplier in the aerospace industry.

Omega Precision (Omega) was founded more than 40 years ago, and has earned a reputation for quality and machining expertise by performing close-tolerance machining on a wide variety of materials. Omega employs thirty highly-skilled craftsmen and professionals using state-of-the-art manufacturing technology at their Santa Fe Springs facility.

CMTC used the results of the assessments to work with Omega to examine both internal and sub-tier capabilities, and ways to enable Omega to greatly increase their capacity as an aerospace supplier. Omega has responded to the desire of primes to provide higher levels of value and integrated solutions by developing a

widened range of subcontractors, as well as the capability to manage them. This has resulted in Omega being selected by The Boeing Company as Supplier of the Year in May 2008. These improvements have also resulted in Omega winning a large program requiring the use and management of several sub-tier contractors. This growth in supply chain management ability has resulted in an increase in business of more than 15% over the last year.

Results of the assessments completed by Omega will be used to structure additional training and provision of resources to continue Omega's growth and strengthen their place in the Aerospace and Defense supply chain.



a NIST | Network  
MEP | Affiliate

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## DELIVERABLES AND NEXT STEPS

### NOVA WIRED DELIVERABLES AND NEXT STEPS

#### NOVA—Supplier Resources & WIB (Workforce Investment Board) White Paper

NOVA (North Valley Job Training Consortium) is a nonprofit, federally funded employment and training agency that provides customer-focused workforce development services. It works closely with local businesses, educators and job seekers to ensure that its programs provide opportunities that build the knowledge, skills and attitudes necessary to address the workforce needs of the Silicon Valley. NOVA is funded by grants from multiple funding sources, primarily the Workforce Investment Act (WIA). By far the largest percentage of NOVA's annual budget comes from competitive grant proposals funded through the U.S. Department of Labor and the State Employment Development Department.

NOVA is a partner on three WIRED projects.

NOVA will develop a central Resources Directory for suppliers, focused on



addressing requirements of the Supplier Transformation Survey and Forum results. NOVA will also publish a white paper targeted to workforce investment boards providing an introduction to supply chain management and, based on the survey results, recommendations as to how the workforce boards may play a role in meeting the workforce development needs of suppliers.



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## USC WESRAC WIRED DELIVERABLES AND NEXT STEPS

The Western Research Application Center (WESRAC) is a research center at the USC Viterbi School of Engineering organized to bring technical assistance to organizations in the communities and region of the University. USC WESRAC WIRED 2.2 efforts are focused on the creation of a Web based virtual supply chain campus. Several buildings with complementing discipline topics provide a “learning about” environment that supports the keystone simulation building. The building presently houses the NetLogo “Beer Game” simulation. (<http://wesrac.usc.edu/wired/>). This simulation provides a demonstration of the complex and counter intuitive nature of dynamic systems such as a supply chain. The simulation center will evolve into a site for a learning object simulation that

will immerse the learning in an online gaming environment that will capitalize on the new online learning paradigms that are complementary to the study of system dynamics and socialization of virtual systems.

Next steps include contributions for an upcoming supply chain book, the emphasis of which will be on modern supply chain theories that derive from complex dynamic systems and self-organizing solutions. Currently WESRAC and other WIRED 2.2 partners are investigating the possibility of moving the supply chain campus to second life, a virtual world learning experience that will allow for the development of a true heuristic experience that will contribute to participants’ ability to transfer lessons learned into real world work environments.



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## APPENDIX A: Antelope Valley Community College District Board of Trustees

Betty J. Wienke, President  
Steve Fox, Vice President  
Jack Seefus, Clerk

Steve Buffalo, Member  
Earl J. Wilson, Member  
Elizabeth Soos, Student Trustee

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Raytheon  
**Wally Aguilar**  
State of California  
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Cerritos College  
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**Larry Arroues**  
Trio Tool & Die Company Incorporated  
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**Myles D. Crandall**  
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Ideal Hire Technologies, Incorporated  
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**Michael Curran**  
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**Trent Darling**  
SMC Space Logistics Group  
**Jim Dato**  
Houghton International Inc.  
**Jeremy Davies**  
British American Business Council  
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Durr Systems Inc.  
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**Kevin Onderdonk**

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**John Pollock**

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**Kim Smith**

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**Aunali Soni**

Honeywell International

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**Kelly Stensen**

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**Phil Sutton**

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**Tod Sword**

Southern California Edison

**Paul Thoreson**

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**Mark Tomlinson**

Society of Manufacturing Engineers

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Antelope Valley College

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Worldwide Quality Network Incorporated

**JoCeal Urbaniak**

Worldwide Quality Network

**Maggie Urrutia**

Preco Manufacturing Company

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Space Exploration Technologies

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California Manufacturing Technology Consulting

**Bud Weisbart**

AR Tech

**Robert White**

Northrop Grumman Corporation

**John Wooten**

CalRAM, Inc.

**Harrison Yelton**

SpaceDev, Incorporated

**Joe Zavilla**

Dion and Sons, Inc.

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## APPENDIX C: Department of Labor Workforce Integrated Regional Economic Development (WIRED) funded partners and unfunded collaborators

ACE Clearwater Enterprises	Employment Training Panel, State of California	Riverside County Economic Development Agency, Workforce Division
Aerospace Corporation, The	Garvey Spacecraft Corporation/California State University, Long Beach	San Bernardino County Workforce Investment Board
Allan Hancock College	Golden Capital Network	San Diego East County Economic Development Council/Connectory
Antelope Valley Board of Trade	Greater Antelope Valley Economic Alliance	San Diego Workforce Partnership
Antelope Valley College	Hannover Fairs USA, Incorporated	Santa Maria Valley Chamber of Commerce/Economic Development Commission
Bay Area Council Economic Institute (BACEI)	Kelly Space & Technology, Incorporated	South Bay Economic Development Partnership
Boeing Company, The	Kern County Workforce Investment Board	South Bay Science Foundation
California Council on Science & Technology	Kern Economic Development Corporation	South Bay Workforce Investment Board
California Manufacturing Technology Consulting	L5 Performance Systems	Southern California Edison
California Space Authority	Lockheed Martin Space Systems Company	Space Exploration Technologies
California Space Education & Workforce Institute	Los Angeles County Economic Development Corporation	Space Information Laboratories, Incorporated
California State Polytechnic University, Pomona	Los Angeles City Workforce Investment Board	Space Systems/Loral
California State Polytechnic University, San Luis Obispo	Los Angeles County Workforce Investment Board	Stanford University/Space Systems Development Laboratory
California Troops to Teachers	Mains Associates	Stauffer Communications, LLC
California Workforce Association	Mathematics Engineering Science Achievement (MESA)	Strategic Innovations Group
Cerritos College/Center for Applied Competitive Technologies	Mission Community Services Corporation/ Women's Entrepreneurial Ventures	Strategic Vitality, LLC
Chabin Concepts	NASA Ames Research Center	Supplier Excellence Alliance
City of Lancaster, Lancaster University Center/The Aerospace Office	NASA Dryden Flight Research Center	University of California, Riverside/Bourns College of Engineering
City of Lompoc Economic Development Office	NASA Jet Propulsion Laboratory	University of California, Santa Cruz, Extension
College of the Canyons	Naval Postgraduate School	University of Southern California, Viterbi School of Engineering, Western Regional Applications Center (WESRAC)
CONNECT	Northrop Grumman Corporation	Ventura County Economic Development Association
Economic Alliance of the San Fernando Valley	NOVA – North (Santa Clara) Valley Workforce Investment Board	Workforce Development Centers of Riverside County
Economic Vitality Corporation of San Luis Obispo County	Orange County Business Council	Workforce Investment Board of Ventura County
El Camino College	Orange County Workforce Investment Board	
Employment Development Department, Labor and Workforce Development Agency, State of California	Private Industry Council of San Luis Obispo County	
	Raytheon Company	

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Housing Agency (BTHA)

**Bryan Scurry** – Deputy  
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Space and Naval Warfare  
Systems Command (SPAWAR)

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Technical Alliances, Office of the Chief  
Engineer  
Northrop Grumman Space Technology

### Robert Twiggs

Director  
Space Systems Development  
Laboratory  
Department of Aeronautics &  
Astronautics  
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**Stephen Bridge**  
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Bridge Business & Engineering  
Services

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## APPENDIX F: Representative List of Supplier Transformation Forum Participants

### PANELISTS

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**Pam Hurt**  
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**Bill Jeffries**  
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**William Johns**  
Senior Systems Technology, Inc.

**Kellie Johnson**  
ACE Clearwater Enterprises

**Bill Keough**  
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**Charles Lundberg**  
Employment Training Panel

**Travis Mack**  
Saalex Solutions Inc

**Frank Maggione**  
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**Dr. Keith Moo Young**  
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**Ty Romero**  
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**Mike Curran**  
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## APPENDIX F: Representative List of Supplier Transformation Forum Participants

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**Marisa Villanueva**

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**Jan Vogel**

South Bay WIB

**Jason Vogel**

CSU Dominguez Hills Cont and Ext. Ed.

**Bud Weisbart**

AR Tech

**Craig Williams**

Premier Metal Products

**Graham Wood**

Graken Corp

**John Wooten**

CalRAM, Inc.

**Karl Zirpel**

SGIS