NORTHWEST COLLABORATORY FOR SUSTAINABLE MANUFACTURING

FEASIBILITY REPORT

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EXECUTIVE SUMMARY

A team of three faculty members from the University of Oregon was retained in July 2012 to work in collaboration with Manufacturing 21 (MFG 21) and Portland Development Commission (PDC) to assess the feasibility for establishing the Northwest Collaboratory for Sustainable Manufacturing (NWCSM). The goal of this project was to assess the interests and needs of various stakeholders in the proposed collaboratory, which is designed to bring together industry and educational institutions to support business and technological needs through research, experiential education, and workforce training and development. This study also provides relevant options for configuring, governing, and operating this collaboratory.

Research

A detailed diagram of the supply chain eco-system helped develop familiarity with key issues. The project then used a number of methods of understanding the dynamics of the metals industry and considering the needs and issues of companies which are operating within Oregon and SW Washington. These methods included the following:

- Reviewing current industry reports by sector
- Reviewing previously written reports about the industry within Oregon
- Developing an updated database of industry participants in the targeted region
- Conducting telephone and in-person interviews with executives of thirteen (13) companies across the major NAICS categories, with the companies identified and prioritized by the project's liaisons at MFG 21 and the PDC
- Developing and administering an online survey sent to more than 740 companies throughout Oregon and SW Washington from the established industry database.

The team conducted an initial review of secondary industry research with more than thirty (30) detailed industry reports. The major themes that emerged from these industry reports helped shape the direction of the project's benchmarking, industry outreach, university discussions, and association/agency interviews.

Database of Companies

We then developed an overall database of companies in the targeted NAICS clusters throughout Oregon and Clark County in Washington using the four primary NAICS codes shown below:

- 331 - Primary Metal Manufacturing
- 332 - Fabricated Metal Product Manufacturing
- 333 - Machinery Manufacturing
- 336 - Transportation Equipment Manufacturing

Interviews and Surveys
Personal interviews and an online survey collected information regarding the opinions and insights of organizations throughout the Oregon and SW Washington region. The interviews and surveys explored the overall perspectives of each stakeholder group and their interest in the proposed collaboratory, the benefits they believe can accrue from this type of organization, and the likelihood that they would indeed participate.

Best Practices
A number of critical success factors or "best practices" emerged to guide the development of the NWCSM from secondary research done on academic studies and website reviews of collaboratories, as well as the invaluable primary interviews and communications with a selected number of collaboratories. The primary research for this part of the project involved identifying forty two (42) programs around the world through online searches. The list was subsequently reduced to a smaller set of twenty-nine (29) of the most relevant programs that were evaluated in greater detail. This research suggests that successful collaboratories:

- Have a clear and focused strategic value proposition
- Recognize and respect the mutual interests of each partner
- Match projects with academic, scientific, and commercial resources and input
- Structure operations and agreements to be flexible, responsive, and timely
- Hire staff to build networks, understand and match needs, and bring parties together
- Build linkages outside of the region and the focal industry cluster where appropriate.

The research sought to gain insights into the issues facing the potential industry, government and educational stakeholders and participants in the NWCSM and then compare those to the lessons learned from successful benchmarked programs.

Business Imperatives
Out of our conclusions come the following imperatives for the NWCSM:

- Be focused and nimble to start
- Build on existing successes, particularly that of the Oregon Metals Initiative
- Have a phased evolutionary program
- Invest in human capital and virtual infrastructure rather than bricks-and-mortar
- Have clear milestones of success
- Integrate industry and academics not just on governance, but on the projects, programs and operational side
- Build substantive longer term commitments for industry funding before proceeding
- Validate the evolutionary recommendations with those who will be participating
- Share equipment or lab investments among the educational stakeholders as well as industry participants

Recommendations

Using the same topics from the benchmarking institutions, we recommend that NWSCM be built upon the following fundamentals:

- **Scope of Industry Served:** NWSCM should continue with its planned focus on the metals manufacturing industry, broadened to include the larger supply chain or ecosystem including suppliers and customers.
- **Industry Engagement:** NWSCM must explicitly work to include small, medium-sized, and large firms in the region.
- **Scope of Services, Projects and Research:** The primary initial focus of NWCSM should be to expand university-industry linkages in the areas of applied engineering, technology and operations.
- **Breadth and Balance of Network:** Workforce development and technical training are of greatest interest to industry, but should not be the primary program focus of NWCSM. Building strong network relationships with organizations to provide resources in lean manufacturing and other areas of expertise will enable the collaboratory to act as a 'concierge' to members.
- **Faculty, Students and Workforce:** The selection and matching of projects to faculty interests must be done with an appreciation of the need to balance academic interests with competitive imperatives for a given firm.
- **Structure:** NWCSM must be structured as a connector between the universities and industry with a lean and flexible staff to efficiently deliver services.
- **Financial Commitments and Revenue Model:** NWCSM needs a substantive multi-year commitment from the state, governmental organizations, and founding/leading corporate members of the industry.
- **Governance:** The NWCSM governance structure must include members of each core stakeholder group.

Immediate Next Steps to Further Validate Scale and Scope for NWCSM

- Organize a major NWCSM kickoff retreat to engage a) key faculty across Oregon University System (OUS) and Washington State University, Vancouver (WSU-V) with significant interest in academic and applied research related to the needs of the metals firms; b) department chairs; c) deans; d) members of the industry; e) other key stakeholders (e.g. PDC and other economic development agencies) to understand assets, expertise, and capacity across OUS and WSU-V vis-à-vis the demand for business and technological needs of metals manufacturing firms.
  - Explicate the nature, scale, and scope of the technological needs of the metals-based manufacturing sector in the region.
  - Identify key assets, expertise, and capacity required in OUS and WSU-V with reasonable specificity (to meet industry needs for applied research and technical services).

- Discussion at the retreat should be primarily moderated by an academic champion (engineering faculty/chair/dean/provost) and a couple of representative champions in the industry.
- The following questions must be addressed
  - What is the overarching need to go well beyond the current state of OMI?
  - What is the portfolio of the work that can be undertaken using the expertise and capacity of tenure track research faculty via senior projects, internships, masters theses, and doctoral dissertations?
  - What is the portfolio of work that can be undertaken by using the expertise and capacity of non-tenure track research faculty via senior projects, internships, and masters theses?
  - What type of equipment, lab, & other infrastructure is needed to support the needs of the industry?
  - How to facilitate the expansion of OMI in a manner that results in a synergistic, flexible, autonomous, scalable, and seamless interaction with NWCSM?
- At the end of the retreat, it should become abundantly clear to all parties as to the specific nature of OUS and WSU-V assets that are needed to support the technological needs of the metals-based manufacturing sector. It must result in a compelling imperative for NWCSM to justify taking the next steps as outlined by the blueprint for guiding a phased implementation.

- Subsequently, a core team comprising members from engineering schools and pivotal partner firms should perform a thorough gap analysis for the right type of both faculty capacity and infrastructure (labs and equipment) vis-à-vis the nature, scale, and scope of the technological support envisioned for the industry over the next five years.
- Sub-groups can be formed with representatives from key stakeholders across NWCSM to further explore the specifics of the nature of pull from the industry and push (supply) of faculty expertise/capacity. It will also be important to have representatives of the economic development entities present during these discussions to gain a first-hand view of the needs of the metals-based industry eco-system.
- Business schools across NWCSM should find it relatively easy to engage with metals manufacturing firms in applied research, benchmarking, experiential education initiatives (i.e., problem solving projects with students), and continuing/executive education to offer the requisite capacity to enhance sustainability and competitiveness of metals manufacturing firms in the region.
- Once the value proposition being offered by NWCSM is clear and compelling to all key stakeholders, the discussion can shift to governance, implementation, and budgetary issues.

An Evolutionary Model

The implementation of the NWCSM will occur in a two-phase growth model over the next five years. Stage 1 will advance the engineering needs of the industry as the infrastructure is set up for the first two years of operation. This will include supporting the expansion of OMI by leveraging common faculty. The NWCSM organization will establish a number of priorities for its staff to facilitate forming relationships between universities and industries, industry outreach, developing faculty and resources, building and maintaining a virtual communications hub, developing marketing materials, establishing funding and managing milestones.

Stage 2 (i.e., Years 3, 4, & 5) will build on these initiatives and continue to offer programs to support applied and relatively short-term engineering needs of the industry while also bringing longer-term research projects for the industry into the mix. Projects will continue to be done on a company-specific and proprietary basis, but evidence of both inter-university collaboration and industry shared projects begins to emerge, spurred on by NWCSM Board of Directors and member groups striving to gain synergies through gainful collaborations across the collaboratory. NWCSM begins to build advanced manufacturing capabilities at large, extending beyond the metals cluster, up and down the supply chain to offer full service to the manufacturing base. The scale and scope of projects focused on larger business challenges increases as they also include issues related to strategy, operations, supply chain, and sustainability. There is now in place an active membership model spanning large to smaller firms complemented by discrete programs.

Financial Implications

The financial requirements to support this evolutionary model are substantial and will require an industry with longer term start-up commitments, industry involvement with an engaged membership revenue stream, OUS support for faculty positions, and state of Oregon funding for the cluster. Our initial estimates of the implications of the proposed model are as follows:

Stage 1: Years 1 and 2

- **OMI Expansion**: OMI expansion will go through the existing OMI channels, funded by industry and matched by state funds. Efforts should be made to double the size of the OMI budget from approximately $900,000 per biennium to $2 million per biennium and to establish an additional $ 1 million seed fund that would provide $500,000 per year to the OMI during Stage 1. Starting up an OMI Seed Fund requires additional work to set up, but we would expect that to be funded by industry and the state overall, particularly given the potential impact this would have on the state's smaller and fastest growing members of the cluster.
- **Applied Research Faculty Positions:** The OUS should expect to fund five new faculty positions from OUS and/or state monies. For planning purposes we have assumed that it will be necessary to make these hires from out of the region. Total cost for this effort would be approximately $2.1-$2.2 million over three years, with the potential need to fund labs or equipment as well.
- **NWCSM Capacity:** Hire one director for Year 1 and grow staff to include administrative support in Year 2. Total staff and organizational costs for the first two years are

estimated at $665-$670K.

- **Membership Revenue:** Founding member membership model has to start at Year 1 before NWCSM is started. Operating funds and staff for NWCSM will be paid from these monies. Tier 2 and 3 membership model to start at Year 2. Amount to be determined.

Stage 2: Years 3, 4, & 5

- **OMI Expansion:** OMI continues to run with a larger number of projects from Stage 1, but may begin to extend into longer term projects and new engineering areas as per the needs of the industry. Annual budget for OMI is expected to be $2.5M in Stage 2.
- **New OUS Capacity:** Determine need and demand for additional applied research faculty in engineering based on progress and milestones met in Stage 1. The annual budget to support faculty increases from $700K in Stage 1 to $1.0M in Stage 2. At the dean or provost levels, begin to develop commitment for material sciences expertise across a wider gamut of technologies that will be highly interlinked and distributed across campuses. The financial feasibility and long term attractiveness of adding this new program were out of scope for this project. Also, integrate expertise/capacity at business schools across NWCSM to support metals manufacturing firms. This holistic expansion to meet both business and technological needs of the metals industry should support a budget of $350K per year for the business schools in NWCSM.
- **New NWCSM Capacity:** Retain Stage 1 director and administrative assistant, but add membership director and program director. Total organizational and staff costs increase to $670K per year in Stage 2.
- **Membership Revenue:** At this point membership fees should be expanding as a percentage of total revenue. Second and third tier membership fees should also be emerging as a significant source of revenue.

Goals and Milestones

The most successful collaboratories set out their goals and then put in place performance measures to track successful accomplishment of these milestones.

For the first phase of NWCSM (Years 1 & 2) at least some, if not all, of the following measures should be considered:

- A total **annual budget of $2.5M - $3.0M** to fund operations of staff of NWCSM, core OUS/WSU-V faculty in NWCSM, and expanded OMI projects
- Staff of two to three
- Five new faculty within OUS or WSU-V who are working on these issues more than 80% of the time
- Increase in graduate students who are working on these projects and are therefore funded for their studies
- Publications and presentations on project results
- Public relations hits on NWCSM's activities

- Membership agreements developed and put in place
- Virtual presence and online experience usage
- Member satisfaction
- Operation of a full board of directors representing all stakeholders

For the second phase of NWCSM (Years 3, 4, & 5) at least some, if not all, of the following measures should be considered:

- A total **annual budget of $4.5 - $5.0M** to fund operations of staff of NWCSM, core OUS/WSU-V faculty in NWCSM, and expanded OMI projects
- Staff of four+
- Increase in members by tier
- Membership retention rates
- Number of completed projects
- Number of programs and events run
- Attendance and participation by event
- Increase in graduate students who are working on these projects and are therefore funded for their studies
- Publications and presentations on project results
- Public relations hits on NWCSM's activities

PROJECT OBJECTIVE AND BACKGROUND

Project Objective

Over the last few years, various constituents have had conversations about the value of developing an organization focused on the metals manufacturing industry that would leverage a public-private partnership involving industry, educational institutions, and government agencies throughout Oregon and SW Washington. These conversations, and subsequent work to develop a proposal for review by the state legislature and the Oregon University System (OUS) have addressed how to bring together these stakeholders to enable industry to connect with educational institutions for supporting some of their business and technological needs via research, experiential education, and workforce training and development, among others.

A team of three faculty members from the Lundquist College of Business at the University of Oregon were retained in July 2012 to work in collaboration with Manufacturing 21 (MFG 21) and Portland Development Commission (PDC) to assess the feasibility for establishing the Northwest Collaboratory for Sustainable Manufacturing (NWCSM). The goal of this project was to assess the interests and needs of various stakeholders in the proposed collaboratory, study the practices of similar organizations, and develop a preliminary time-phased blueprint for NWCSM. The ultimate goal of this study was to provide relevant options for configuring, governing, and operationalizing this collaboratory.

Industry Definition

Based on input from MFG21 and the PDC, the industry under review was defined as the following four primary NAICS codes:

- 331 - Primary Metal Manufacturing
- 332 - Fabricated Metal Product Manufacturing
- 333 - Machinery Manufacturing
- 336 - Transportation Equipment Manufacturing

It should be noted that based on input from MFG 21 and the PDC, a decision was made not to include firms from two other sectors – metals wholesaling (NAICS 423510) and metals recycling (NAICS 562920) – even though these two sectors are also part of the complex supply chain for the industry. The detailed NAICS codes that were included in the industry definition are provided in Appendix A.

INDUSTRY RESEARCH - CURRENT CHALLENGES IN METALS MANUFACTURING

The project used a number of methods of understanding the dynamics of the metals industry in addition to considering the needs and issues of companies who are operating within Oregon and SW Washington.

- Reviewing current industry reports by sector
- Reviewing previously written reports about the industry within Oregon
- Developing an updated database of industry participants in the targeted region
- Conducting telephone and in-person interviews with executives of thirteen (13) companies across the major NAICS categories, with the companies identified and prioritized by the project's liaisons at MFG 21 and the PDC
- Developing and administering an online survey sent to more than 740 companies throughout Oregon and SW Washington from the established industry database.

A Complex Supply Chain

To develop a familiarity with the issues facing the industry overall, the team conducted an initial review of secondary industry research produced by IBIS World. More than thirty (30) detailed industry reports at a 6 digit NAICS industry code level were accessed and reviewed. The major themes that emerged from these industry reports helped shape the direction of the project's benchmarking, industry outreach, university discussions, and association/agency interviews.

The top ten (10) themes from these industry reports include:

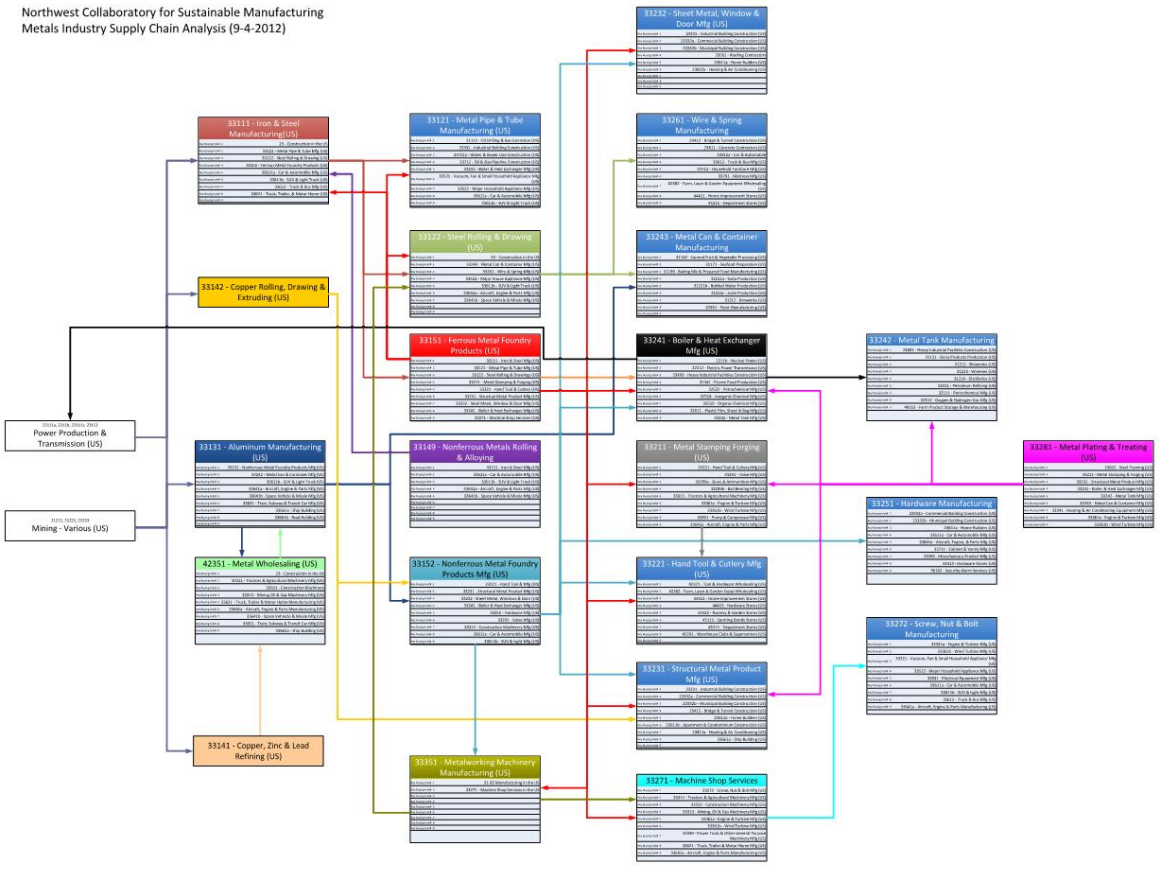
- Difficulty in forecasting demand due to uneven sector recovery from the 2007-2008 recession, but most sectors are experiencing some improvement in demand that has not yet flowed into margins or profits
- Commodity input prices continue to be volatile, with the ability to pass on these cost increases to downstream customers varying greatly by sector
- Continued pressure to reduce prices and improve quality in an increasingly competitive environment
- Increased pressure in some sectors to global competition, leading US producers to try to find ways to retain customers, introduce differentiated or higher value added products, begin to export themselves, or control niches as a way to reduce vulnerability to price competition
- Industry consolidation emerges as a way to increase operational efficiency and streamline employment
- Heightened executive concern about the reliability of supply chains, access to key inputs, and protection from supply chain disruptions emerges after a series of natural disasters
- Access to technological improvements and innovations is essential to increase efficiency of operations, develop new products, and increase overall competitiveness
- Some customers are beginning to expect that suppliers can provide integrated services

that encompass working with them on design, engineering, and distribution, including reducing costs and time of shipment by moving closer to customers and markets

- Access to and retention of a skilled and trained workforce increases as a management issue as older workers reach retirement
- Environmental laws and regulations are increasing, causing management to try to get ahead of the issues proactively in order to reduce the cost of compliance, realize operational cost savings, and reduce business risks.

One of the most valuable parts of the IBIS World reports was the section dealing with the supply chain buying and selling relationships between individual NAICS code sectors. Since the overall intent of the NWCSM is to promote the entire industry cluster, the information in this part of the IBIS World reports allowed the team to develop an overall map of the complex interrelationships that need to be supported within the cluster. This supply map is in Exhibit 1 below, but has also been provided separately in electronic form so that it can be viewed at a larger scale.

Exhibit 1: Supply Map



Source: Developed from industry reports prepared by IBIS World, accessed through University of Oregon Library.

Previous Studies of the Industry in the Region

In 1998 the firm Impresa produced an overall assessment of the metals industry for the Oregon Metals Industry Council[1]. Key findings from that work include:

- Oregon's metals industry consisted of more than 1,700 firms, directly employing more than 55,000 workers.
- The metals industry creates good paying jobs; the average salary for those employees was about one-third more than the average of other workers in Oregon, at about $35,000 per year.
- The industry displayed a large degree of integration with suppliers and customers. In fact, the direct economic impact of the industry included not only its own employment and payrolls, but also purchases of supplies from other Oregon businesses and sales to customers in the region. The Impresa studied concluded that about 62% of the purchased inputs (excluding labor, capital and wholesale markup) were purchased from other regional firms in the metals industry.
- Firms in the industry were heavily concentrated in the northern part of the state, around the Portland metropolitan area. The Impresa study concluded that nearly 2/3 of all metals industry employment was concentrated in the Portland area.
- Other geographic areas that had a notable metals industry presence were Linn, Marion and Lane counties within the Willamette Valley as well as Jackson, Wasco, Deschutes and Douglas.

Some of these same themes are echoed in the most recent study of the regional cluster in the "Advanced Manufacturing Cluster - Inventory Phase" produced by the Portland Development Commission in July 2010[2]. While focused almost entirely on the metals manufacturing cluster within the Portland region (Multnomah, Washington and Clackamas counties), the study also identified in Exhibit 2 below that total statewide employment in the metals industry had dropped to 42,000, representing a decline of more than 13,000 workers in a decade.

Exhibit 2: Advanced Manufacturing - 2009 Statewide Employment, Payroll, and Average Wage

NAICS	Industry	Employment	Payroll	Average Pay 2009
331	Primary Metal Manufacturing	8,113	$482,410,537	$59,461
332	Fabricated Metal Product Manufacturing	13,971	$608,105,911	$43,526
333	Machinery Manufacturing	9,727	$536,755,738	$55,182
336	Transportation Equipment Manufacturing	9,960	$507,811,428	$50,985
Total for these four NAICS:		**41,771**	**$2,135,083,614**	**$51,114**

[1] Impresa, " Metals Industry Economic Impact and Supplier Linkages In Oregon", November 1998, provided to the Oregon Metals Industry Council.

[2] "Advanced Manufacturing Cluster - Inventory Phase" produced by the Portland Development Commission in July 2010

Regional employment was declining across the four studied NAICS codes as shown in Exhibit 3. Nearly 31,000 employees in this cluster were in the tri-county area alone, indicating that the regional concentration patterns discussed a decade earlier by Impresa were continuing.

Exhibit 3: Advanced Manufacturing - 2006 – 2009 Tri-County Employment

NAICS	Industry	2007	2008	2009	Average Pay 2009
331	Primary Metal Manufacturing	6,600	7,100	5,800	$59,461
332	Fabricated Metal Product Manufacturing	13,300	13,400	11,000	$43,526
333	Machinery Manufacturing	8,600	8,300	7,100	$55,182
336	Transportation Equipment Manufacturing	9,000	8,600	7,000	$50,985

Developing An Updated Industry Database for NWCSM

As shown above, previous studies of the metals industry cluster clearly demonstrated its overall importance to the state and to key geographic regions within the state. However, the latest official study on a statewide level that we could locate was from 1998. In addition, no previous study we could locate had incorporated the SW Washington geographic area despite the clear contiguous nature of the markets. Therefore, the project team used this information and then set out to collect updated information that could corroborate or even deepen the overall understanding of the industry, its issues, and the ways that the proposed NWCSM could provide value.

We developed an overall database of companies in the targeted NAICS clusters throughout Oregon and Clark County in Washington. Using the *ReferenceUSA* database available through the University of Oregon, searches were done for companies using the same four primary NAICS codes employed by the Portland Development Commission work in 2009:

- 331 - Primary Metal Manufacturing
- 332 - Fabricated Metal Product Manufacturing
- 333 - Machinery Manufacturing
- 336 - Transportation Equipment Manufacturing

A database of 2,910 companies has been provided to MFG 21 and the PDC in electronic format. Again, as noted above, based on input from MFG 21 and the PDC a decision was made not to include firms from two other sectors – metals wholesaling (NAICS 423510) and metals recycling (NAICS 562920). This same set of codes was also excluded from the recent PDC inventory as well as the original 1998 Impresa study. If these firms had been added into the overall database, another 156 companies in Oregon would be included and 20 companies in SW Washington.

ReferenceUSA data provides information specific to each location of a business, thus if a company has three branches in three different locations, three records will be present. Since employment and revenue data is also provided at a location level, and we wanted to see the geographic dispersion of firms by county, the decision was made not to combine records into an overall company level, but to retain the location detail.

As described in Appendix B, the database was evaluated to try to eliminate any duplicate records. However, if we determined that there were two different business names with two different phone numbers and two different NAICS codes operating in the same location, we retained both records. Thus, because of the nature of branch locations as well as multiple companies with multiple "doing business as" names at the same address, it is likely that the *ReferenceUSA* database actually overstates the number of businesses operating in Oregon and SW Washington. The resulting database of 2,910 companies has been provided to MFG 21 and the PDC in electronic format.

Across Oregon, our analysis shows that the total metals industry has approximately $11.6 billion in revenue and 49,500 employees across the state's 2,600 companies. By primary NAICS code this data shows a continued decline in employment in all but the Fabricated Metal Product sector (NAICS 332), which our data shows having an increase in employment statewide of nearly 8,000 jobs compared to the PDC's July 2010 report shown earlier in Exhibit 3. In Washington's Clark County, the 280 companies in the industry generate about $894 million in sales and employ nearly 4,000 people.

Exhibit 4 summarizes the current size of the metals manufacturing industry in Oregon and SW Washington based on the information collected for this project

Exhibit 4: Overall Size of the Metals Manufacturing Industry in Oregon and SW Washington

	Oregon		
	Total Locations	Total Reported Sales	Total Reported Employees
331 - Primary Metal Manufacturing	113	$ 1,339,359,000	6,162
332 - Fabricated Metal Product Manufacturing	1,560	$ 3,822,994,000	21,046
333 - Machinery Manufacturing	642	$ 3,017,756,000	10,975
336 - Transportation Equipment Manufacturing	317	$ 3,454,333,000	11,490
Total	2,632	$ 11,634,442,000	49,673

	Washington (Clark County)		
	Total Locations	Total Reported Sales	Total Reported Employees
331 - Primary Metal Manufacturing	11	$ 36,790,000	355
332 - Fabricated Metal Product Manufacturing	173	$ 353,027,000	1,706
333 - Machinery Manufacturing	72	$ 312,083,000	1,298
336 - Transportation Equipment Manufacturing	22	$ 192,056,000	575
Total	278	$ 893,956,000	3,934

Continued Geographic Concentration

Of the 2,910 records in the study's database, more than 2,600 or 90% of these companies are located in Oregon. Clark County was home to 278 of the company locations.

Within Oregon, the geographic clustering that had been previously reported persists today. The three Portland Metro counties (Clackamas, Multnomah and Washington) together represent more than 47% of the companies in the industry cluster. Lane County has the next highest number of participating companies, representing nearly 11% of the total locations in the state. Exhibit 5 displays the distribution of these Oregon companies by county.

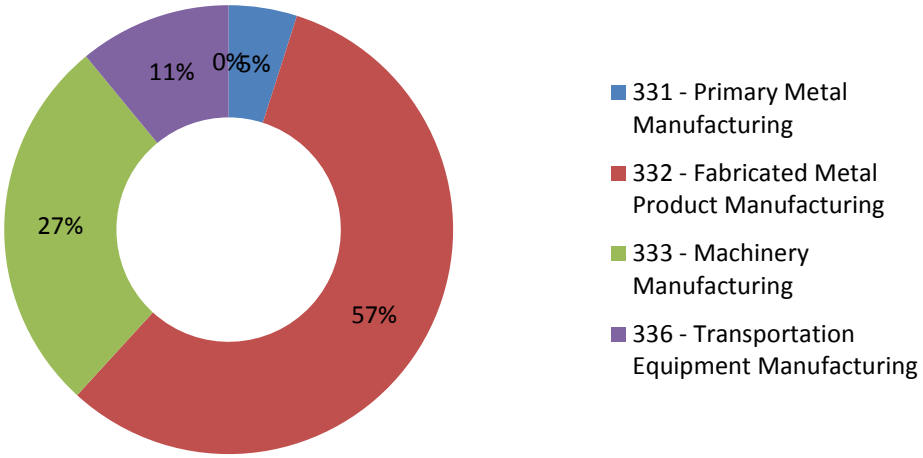
Exhibit 5: Distribution of Company Locations by Oregon County

County	#	Percent
Multnomah	574	21.8%
Clackamas	357	13.6%
Washington	328	12.5%
Lane	278	10.6%
Marion	164	6.2%
Jackson	137	5.2%
Deschutes	130	4.9%
Linn	95	3.6%
Yamhill	66	2.5%
Josephine	58	2.2%
Douglas	51	1.9%
Klamath	39	1.5%

Polk	35	1.3%
Benton	33	1.3%
Columbia	29	1.1%
Coos	26	1.0%
Umatilla	26	1.0%
Baker	22	0.8%
Clatsop	20	0.8%
Malheur	20	0.8%
Curry	18	0.7%
Lincoln	16	0.6%
Crook	14	0.5%
Wallowa	12	0.5%
Hood River	11	0.4%
Tillamook	11	0.4%
Wasco	9	0.3%
Jefferson	8	0.3%
Harney	7	0.3%
Gilliam	3	0.1%
Grant	3	0.1%
Wheeler	3	0.1%
Sherman	1	0.0%
Oregon: All Counties	2632	100.0%

Within Portland Metro, there are a total of 1,259 company locations in the NWCSM database. As shown in Exhibit 6 below, each of the primary NAICS codes are well represented in the cluster.

Exhibit 6: NAICS Representation In the Portland Metro Area (Clackamas, Multnomah, Washington Counties)



When comparing the three counties individually, the data shows that each county has a relatively similar distribution of companies within the four primary NAICS. Of the total companies in each county, between 55% - 59% are in Fabricated Metal (NACIS 332), 25-29% are in Metal Machinery (NAICS 336), and 4-6% in Primary Metal Manufacturing (NAICS 331). Multnomah has a far larger percentage of its companies (14%) in the Transportation Equipment sector (NAICS 336), compared to the lower 8-9% in Clackamas and Washington counties respectively.

The July 2010 PDC report noted earlier that total tri-county employment was approximately 30,900 in 2009. Our updated data on employment within the tri-county area by NAICS code shows a slight decline to 29,140. Exhibit 7 below illustrates this trend.

Exhibit 7: Reported Actual Tri-County Location Employment in Primary NAICS Codes

	Clackamas	Multnomah	Washington	Total
331 - Primary Metal Manufacturing	797	3,065	136	3,998
332 - Fabricated Metal Product Manufacturing	4,247	6,042	2,214	12,503
333 - Machinery Manufacturing	1,899	2,729	2,602	7,230
336 - Transportation Equipment Manufacturing	739	4,191	479	5,409
Total	7,682	16,027	5,431	29,140

From a revenue perspective, the four primary sectors of the metals manufacturing industry represent more than $6 billion in total revenue within the tri-county Portland area shown in Exhibit 8 shown below.

Exhibit 8: Reported Actual Tri-County Location Revenue in Primary NAICS Codes

	Clackamas	Multnomah	Washington	Total
331 - Primary Metal Manufacturing	$ 191,216,000	$ 438,422,000	$ 50,253,000	$679,891,000
332 - Fabricated Metal Product Manufacturing	$ 487,455,000	$1,202,462,000	$ 399,175,000	$ 2,089,092,000
333 - Machinery Manufacturing	$ 499,408,000	$ 798,058,000	$ 571,319,000	$ 1,868,785,000
336 - Transportation Equipment Manufacturing	$ 191,765,000	$ 1,057,833,000	$ 166,228,000	$ 1,415,826,000
Total	**$1,369,844,000**	**$3,496,775,000**	**$1,186,975,000**	**$ 6,053,594,000**

An Economy Driven by Many Smaller and Medium-Sized Firms

Analyzing the updated NWCSM database of 2,910 firms confirms the same conclusions that the industry in the region is dominated by smaller and medium-sized firms as reached by earlier studies. For example, as Exhibit 9 on the next page shows, across the entire sector in Oregon, just over half of the companies report a location employee base of 1-4, with another 17% reporting location employees from 5-9 and 15% reporting having 10-19 employees at the location. 84% of companies in the metals industry in Oregon have less than 20 employees per location.

A similar story exists in Clark County, Washington as well. As shown in Exhibit 10 on the next page, 89% of Clark County companies operate with less than 20 employees per location.

Exhibit 9: Distribution of All Oregon Companies by Employee Size

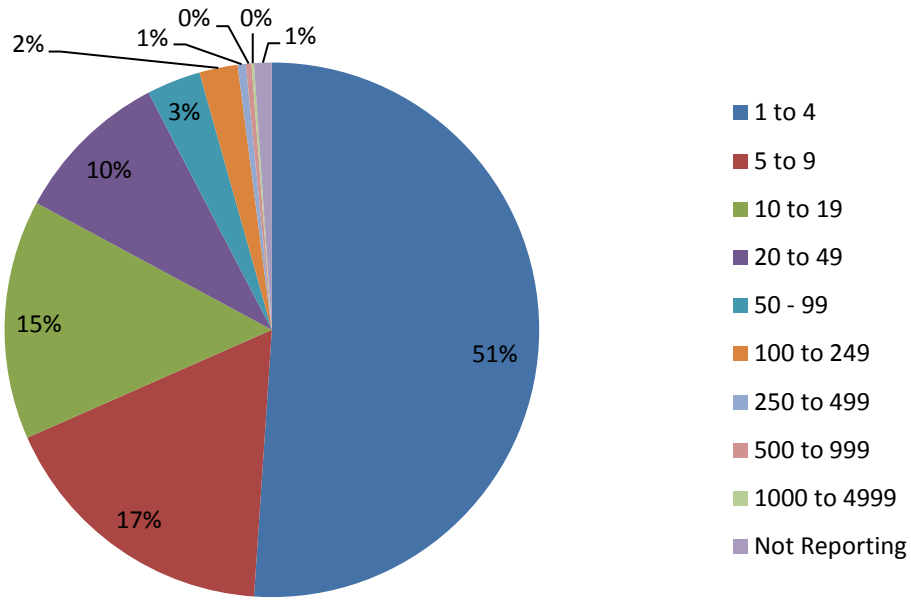
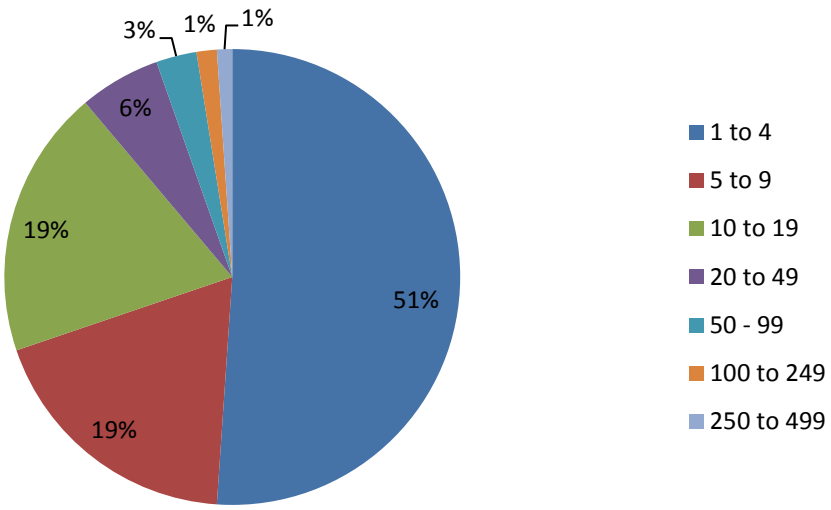


Exhibit 10: Distribution of SW Washington (Clark County) Companies by Employee Size



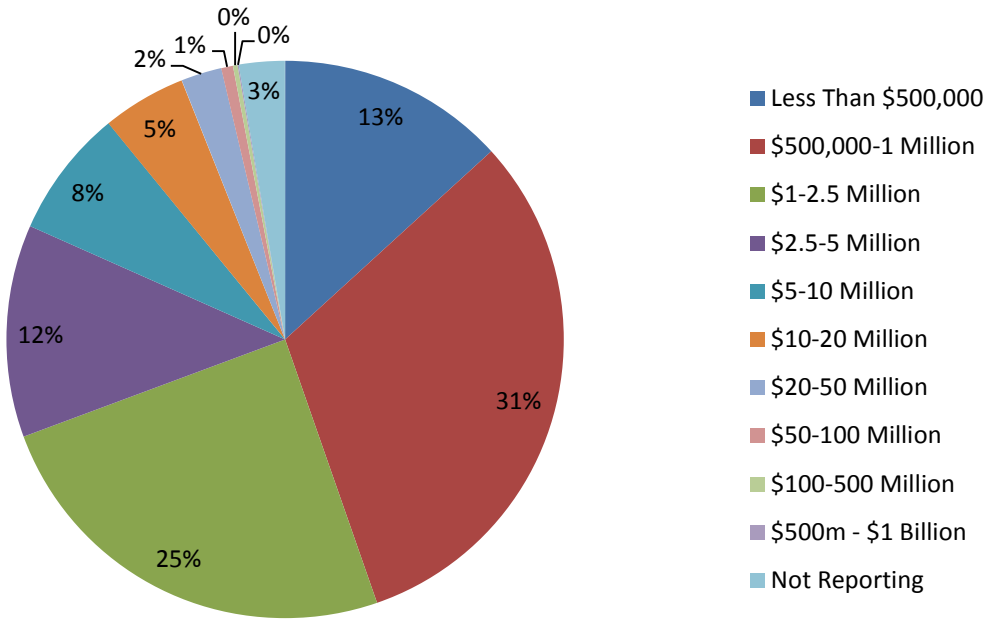
By industrial sector, the Primary Metal Manufacturing and Transportation Equipment Manufacturing sectors have the largest average of actual employees at a location across all of Oregon and in Clark County. Exhibit 11 shows the total number of companies in Oregon and SW Washington by primary NAICS as well as the average actual employees reported per location. Because having one large company in a sector could influence the averages, the median per NAICS is also provided.

Exhibit 11: Average and Median Actual Employees Per Location By Primary NAICS

Primary NAICS	331 - Primary Metal Manufacturing	332 - Fabricated Metal Product Manufacturing	333 - Machinery Manufacturing	336 - Transportation Equipment Manufacturing
Oregon Companies	**113**	**1560**	**642**	**317**
Average Actual Employees	54.6	13.6	17.3	37.1
Median Actual Employees	8	4	6	6
Clark County Companies	**11**	**173**	**72**	**22**
Average Actual Employees	29.9	9.8	18	26.1
Median Actual Employees	25	4	6	4.5

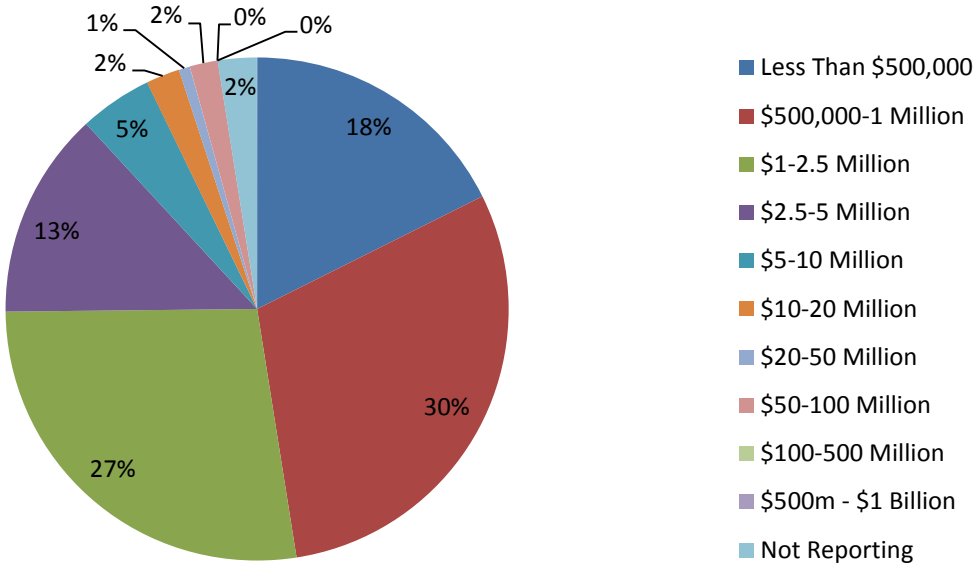
The revenue story is similar with 44% of Oregon locations in the industry report revenue of less than $1 million per year while another 37% report location revenues between $1 and $5 million per year. Thus more than 80% of locations have annual revenues under $5 million per site as shown in Exhibit 12.

Exhibit 12: Distribution of Oregon Companies by Location Revenue



Again, SW Washington mirrors the pattern of its Oregon neighbor. As Exhibit 13 shows, Clark County has even more firms operating under $1 million per location, 48% compared to Oregon's 44%. Another 40% of Clark County firms operate with location revenues between $1 and $5 million per year, leading to a total of nearly 90% of SW Washington firms being below the $5 million per location revenue threshold.

Exhibit 13: Distribution of SW Washington (Clark County) Companies by Location Revenue



By industrial sector, the Primary Metal Manufacturing and Transportation Equipment Manufacturing sectors again have the largest reported levels of revenue by location across all of Oregon and in Clark County. Exhibit 14 below compares the total number of companies in Oregon and SW Washington by primary NAICS with the average and median location revenue.

Exhibit 14: Average and Median Actual Employees Per Location By Primary NAICS

	331 - Primary Metal Manufacturing	332 - Fabricated Metal Product Manufacturing	333 - Machinery Manufacturing	336 - Transportation Equipment Manufacturing
Oregon Companies	**113**	**1560**	**642**	**317**
Average Location Revenue	$ 12,407,833	$2,499,488	$ 4,836,147	$11,616,766
Median Location Revenue	$ 2,480,000	$ 747,000	$1,715,500	$ 2,064,000
Clark County Companies	**11**	**173**	**72**	**22**
Average Location Revenue	$ 4,788,250	$ 2,032,730	$4,458,329	$ 9,145,524
Median Location Revenue	$ 1,980,500	$747,000	$ 1,663,000	$ 2,240,000

In-Person and Telephone Interviews

A total of thirteen (13) telephone and in-person interviews were conducted by the project team during the month of October consisting of twelve (12) phone interviews and one face-to-face interview. A full list of the companies participating in this part of the project is provided in Appendix C. The companies were also invited to participate in the online survey as well. Seven (7) of these companies completed the online survey and those responses are in Appendix F.

The companies interviewed can be categorized in two broad groups referred to as Group A and Group B. Group A consisted of twelve (12) of the companies interviewed and can be described as members of the fabricated metal products manufacturing sector and possess these attributes.

- They have fewer than 100 employees and most often are performing work based on the design and engineering requirement specified by their customers. Most (67%) are members of the fabricated metals product manufacturing sector.
- These companies have strong regional supply chains, with more than 39% of their suppliers located in Oregon/SW Washington or the greater Pacific Northwest. However, from a customer perspective these companies sell throughout the United States, with an average of 43.5% of customers across the US and another 27% globally.
- These companies are quite optimistic about the future business possibilities. More than 2/3 of them expect to add capacity in 2013 since they project that revenue will increase in each of the next four years up through 2016. Of this projected growth in capacity, about 40% of these companies are adding technology and capital investment, rather than workforce expansion.
- Only one respondent was “somewhat” aware of the NWCSM, while all other were

unaware.

- Their association with universities in Oregon and SW Washington is limited and their closest academic ties are with community colleges, specifically Mt. Hood and Clackamas. The most common area in which these companies report having engagement with the university system is in employee and hiring needs, although several also report that they have worked with educational entities on applied technology and materials issues.
- The universities that were most commonly mentioned were OIT, PSU and the University of Portland.
- Industry associations and equipment vendors are a common source of information, and in some cases training, for these companies.
- Their most significant human resource needs focus on metal fabrication and welding skills. These companies desire access to continuing education, employee training and skill development, internship relationships and hiring resources.
- Over the next three years the most important business issues for this group of companies is working to attract new or more diverse customers, keeping existing customers, improving operational efficiency, managing raw material costs, complying with environmental laws, and attracting/retaining a workforce.
- Working with educational entities on these other business needs, such as sustainability relating to cost control and waste management issues and, to a lesser degree business planning, are areas most companies have not explored but they are open to investigate.
- Grants are not something most of these organizations have considered as viable.

Group B was represented by only one company categorized as a large scale manufacturing firm with sophisticated technical design and engineering needs. This company's needs are radically different from Group A with focus on the application of cutting edge technology in all aspects of operations. Although this is an important and influential entity, these comments only represent this single interview.

- The company's engagement with the educational entities in the region has been focused on applied engineering, human resource/recruiting, and even some core research projects.
- The company has current relationships with OIT, Portland State, Washington State, the University of Portland and some activity at the University of Oregon in addition to contacts at the community college level.
- Management considers universities difficult to work with and gives them a grade of a "C" because the institutions have not taken the initiative to get to know, understand and respond to the company's specific needs.
- The company desires additional resources from universities in the areas of applied R&D, engineering, operations and technology.
- Some of its best connections with academia are in Western Europe, specifically Sweden,

where universities have taken the lead role in developing the relationship.

- The single Group B company considers OMI a good local resource for applied technology in the area of corrosion prevention and specifically mentioned that OMI has attributes that offer a good example for NWCSM to follow.

Online Survey

The online survey effort mirrored the same topics as the in-person and telephone interviews just described, but was designed to ensure a wider geographic representation, deeper responses within each NAICS code, and ensure that any final recommendations on the value proposition and structure of the NWCSM incorporate input from the many smaller and medium-sized enterprises throughout the Oregon and SW Washington region. (A copy of the survey is provided in Appendix D.)

An online survey was developed to address key project issues, reviewed with MFG 21 and PDC project liaisons, revised and then deployed. The survey was administered via Qualtrics, a professional survey tool available to University of Oregon faculty and students. Thus, the use of Qualtrics added no cost to the project.

Since the original *ReferenceUSA* database does not provide email addresses for executives, the team undertook an effort to develop the email addresses that were used for this part of the project. The process by which email addresses were collected so that they could be used for the online survey is outlined in Appendix B. As a result of this work, a total of 748 email addresses received the online survey link. Out of these, a total of 55 companies completed the survey, for an overall response rate of 7.3%. While the total number of 55 response may not seem high compared to the overall size of the target industry, it should be noted that this is indeed a comparatively high response rate for this kind of a survey.

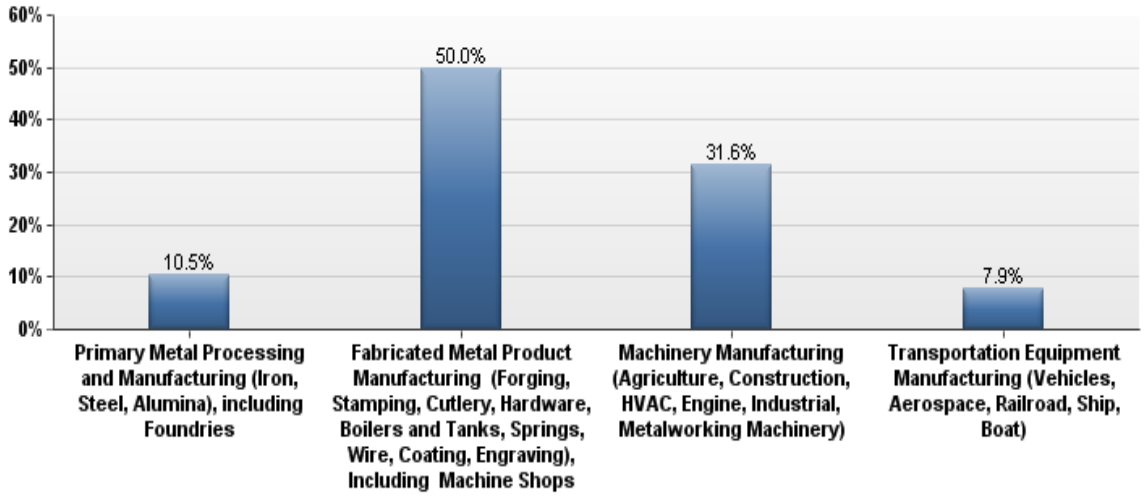
Detailed tabulations for each of the survey's questions are provided in Appendix E. An overall profile of the respondents as well as a summary of some of the major insights from this part of the project is provided in the sections that follow.

<u>Profile of Respondents</u>

As noted above, 55 out of the 748 companies contacted to participate in the online survey actually completed the survey itself. The survey respondents were overwhelming the senior executive in charge of the firm; more than 69% of respondents indicated that they were the CEO, COO or CFO. A total of 12% of the respondents were from the sales organization, not surprising since many of the email addresses that we identified were direct emails to sales executives.

The participating companies represent a mix of the NAICS codes that were targeted as follows, with the majority of firms in either fabricated metal product manufacturing or machinery manufacturing as shown in Exhibit 15.

Exhibit 15: Primary Sector of the Metals Manufacturing Industry that Best Describes the Business (Q2)



Similar to the overall profile of firms in the region, the survey respondents were predominantly smaller in terms of revenue and employees. More than 60% of respondents had annual revenues of less than $2.5 million. Six or 18% of the respondents had annual revenues between $2.5 million and $10 million, with the rest in excess of this number. There was only one company with annual revenues in excess of $100 million.

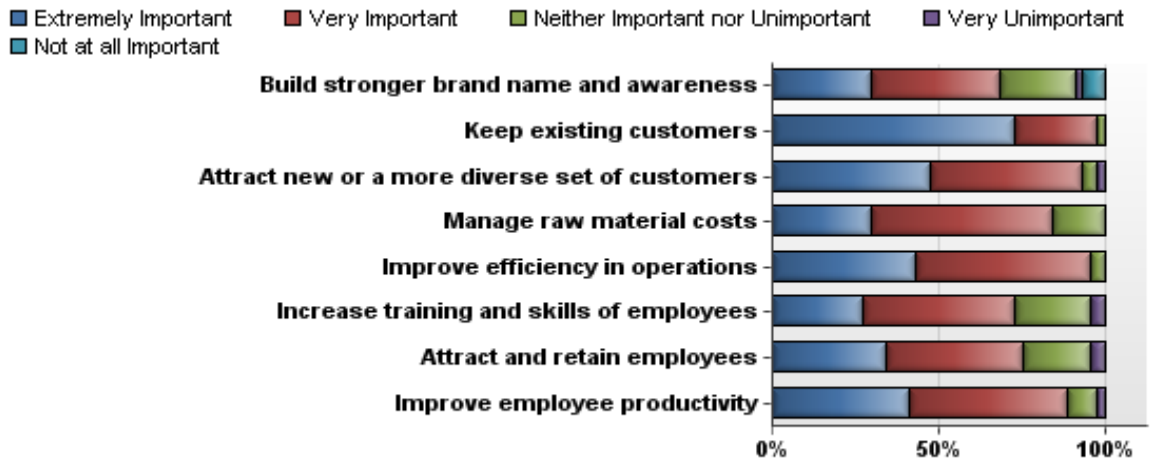
In terms of employees, 48% of the companies had less than 19 employees. There were 13 companies or 39% of the respondents with employees between 20-100 with two companies that have between 100 and 500 employees.

Macro-Industry Issues Facing the Business

Part of the survey was to ask metals manufacturing firms what were their largest concerns over the next few years. Twenty specific topics were provided, falling into a number of major categories: brand awareness and customers, markets, employees, product development and technologies, and operations.

Overall, the companies who participated in the online survey indicate that their most immediate concern among all of the twenty issues posed over the next three years is to keep their existing customers. As shown below, 72.7% of the respondents said this was 'extremely important' and their top priority. Growing the business by attracting new or more diverse customers was the second highest rated priority, with 47.7% rating this as 'extremely important' and 93.2% saying it was either 'extremely' or 'very important'. Building stronger brand awareness, was 'very important' or 'extremely important; to 68% of the respondents, so it is clearly important, but notably less important than customer management and development as shown in Exhibit 16.

Exhibit 16: Most Important Macro-Issues Facing the Business Today (Q5)



If marketing and customer relationships are number one, the next most important priorities are operational efficiency and productivity, with 43.2% of respondents saying improving efficiency in operations as 'extremely important' and 95.5% saying it was either 'extremely' or 'very important'. Within this overall category, the management of raw material costs was the second most important issue, with more than 84% noting it was either 'extremely' or 'very important'. This result is consistent with the many industry wide secondary reports reviewed as part of this project that noted the increasing importance of commodity and raw material cost management.

Not surprisingly, improving employee productivity ranked as priority #4 with 88.6% of respondents saying it was 'extremely' or 'very important' to address over the next three years. Because of the aging of the workforce in the metals manufacturing industry, it was notable that many of the respondents indicated that attracting and retaining employees came in as issue #5 in terms of importance, ahead of increasing training and employee skills. These results are consistent with many of the primary research comments that were made during the primary interviews that were conducted, and which will be summarized later.

The online survey results are consistent with the earlier work done by the Portland Development Commission that this sector does not have a large concern with globalization. In fact, 22.8% of all respondents said that establishing a stronger international market position was 'extremely important' or 'very important' in the next three years. A total of 47.2% of respondents said it was either 'very unimportant' or 'not at all important'. Instead, finding opportunities for new domestic growth was indicated as being 'extremely' or 'very important' by almost 64% of respondents.

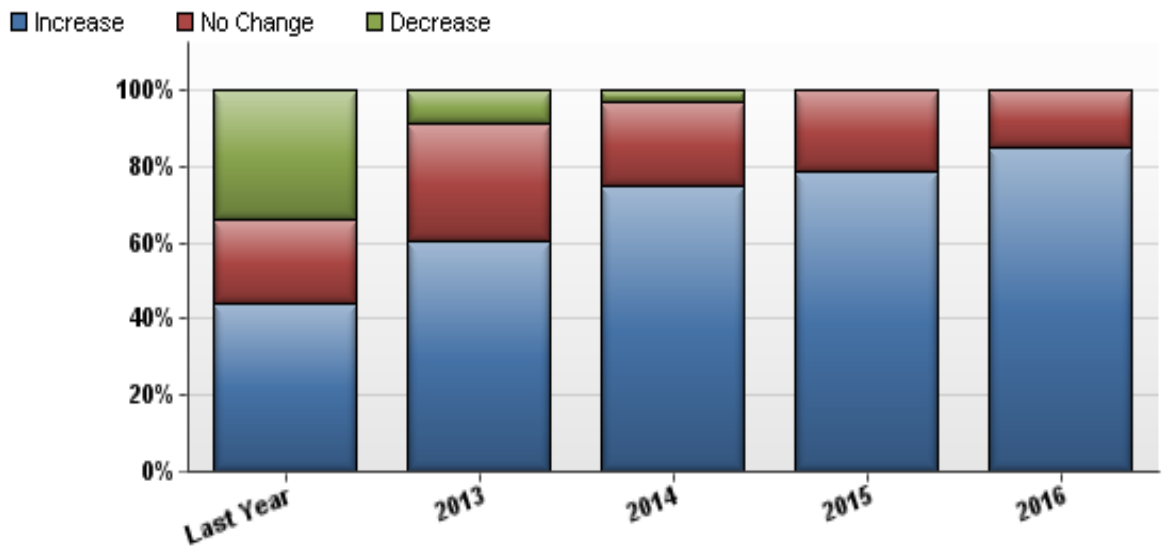
Of particular interest to the proposed NWCSM were the responses given to the questions about use of new technologies, development of new products, and strengthening material development and research. Overall, while companies appear to recognize that these are important for long term success, there were few that said that these were essential priorities

over the next three years. While 59% of respondents indicated that developing new, differentiated or value added products were 'extremely' or 'very' important, only 9% selected the 'extremely important' option. Using new technologies to improve engineering capabilities was 'extremely important' to only 16% of respondents while strengthening material development and research was only 'extremely important' to 2% of the respondents.

Business Forecast

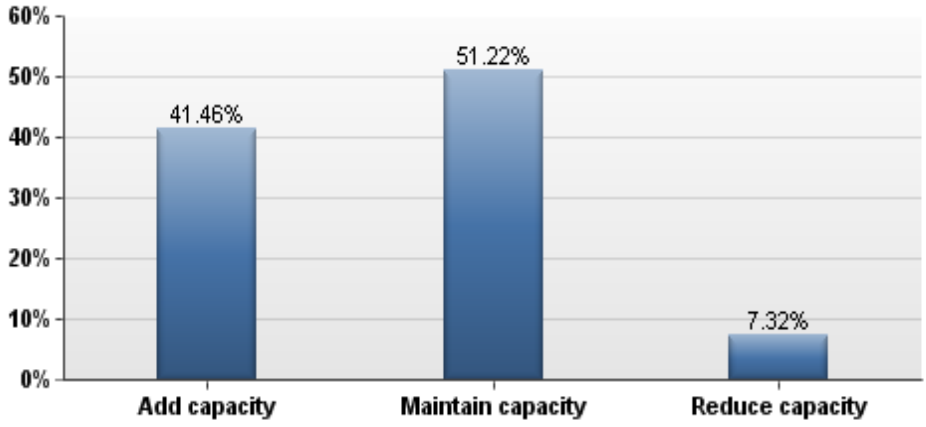
The economic recession that has hit the metals manufacturing industry since 2007 may be coming to an end, or at least that is what the survey respondents believe. As shown below in Exhibit 17, 2011 was still a bad year. More than 34% of respondents indicated that their overall revenue declined but another 44% said revenues had started to increase. However, moving into 2013, only 9% believe that revenues will continue to decline, with nearly 61% saying revenues are expected to increase. Going two through four years out, up to 2016, the revenue projections are even rosier, with more than 75% of firms expecting to see their company's revenues grow.

Exhibit 17: Revenue Projections 2013-2016 (Q7)



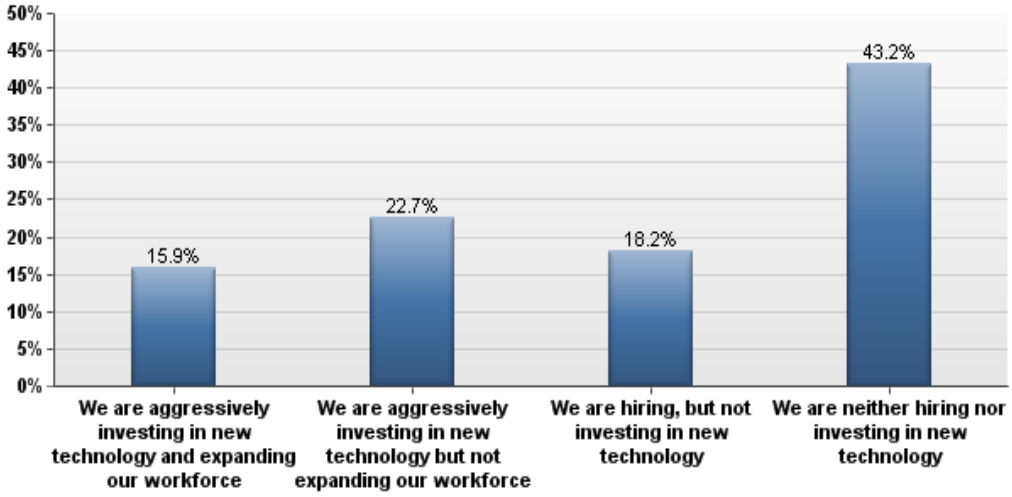
Consistent with this relatively positive revenue picture, the online respondents seem to be relatively confident about growing the business to accommodate new revenue demands. More than 41% of companies indicated that they had plans to add capacity in either equipment, technology or employees. Only 7% of respondents, or 3 companies, indicate that they expect to reduce capacity. The remaining 51% expect to maintain current capacity as shown in Exhibit 18.

Exhibit 18: Business Capacity Expectations in 2013 (Q6)



The specific methods by which companies are planning on capacity range from investing in new technology, expanding the workforce, doing both, or driving for more productivity through current capacity. As shown below in Exhibit 19, more than 43% of companies saying they are not yet hiring or investing in new technology; these firms appear to be taking a 'wait and see' approach to whether revenues really do increase, and then stabilize at these higher levels. However, 23% of firms are beginning to invest in new technology but not hiring while another 18% are hiring but not investing in new technology.

Exhibit 19: Hiring and Investment Plans for 2013 (Q8)



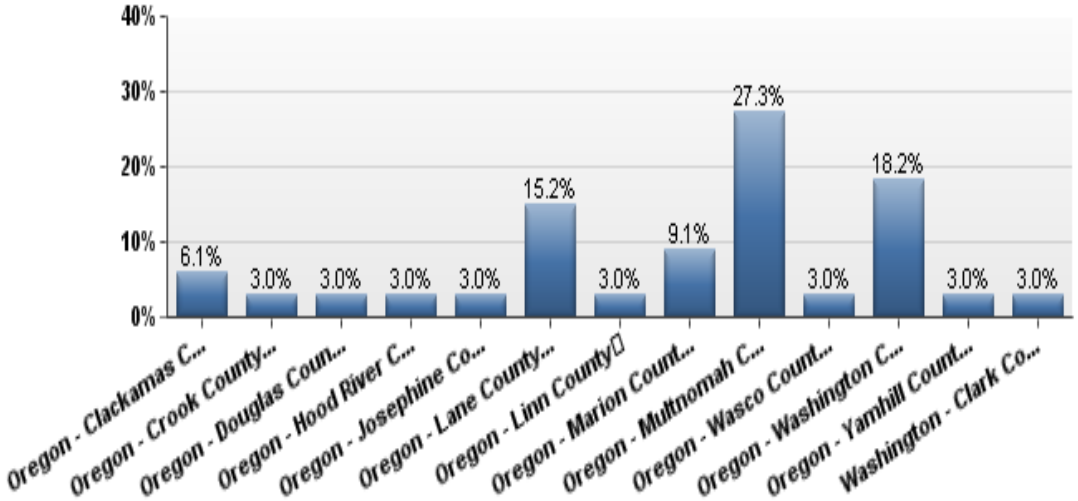
On a sector basis, transportation firms, followed by machinery manufacturing, are most optimistic, with 67% of the transportation firms and 56% of the machinery manufacturing firms respectively indicating that they plan to add capacity. Of the four major sectors, it is fabricated metal product manufacturing firms that continue to indicate a softer economic recovery, with 56% indicating that they plan to maintain capacity, while another 12.5% indicate that they plan to reduce capacity.

When business expansion plans are looked at in terms of size of reporting firm, the results show that the smallest firms (under $2.5 million in annual revenues) generally expect to maintain capacity in 2013. Of the 17 firms in this revenue category, 11 say they will maintain, while 4 say they will add and 2 say they will reduce. In the larger middle market group between $2.5 million and $20 million in annual revenues, 5 of the 8 firms indicate they will add capacity while 3 expect to hold or maintain at 2012 levels. None expect to reduce capacity. In the larger revenue range above $20 million there was a mixed result with no clear pattern, with one firm saying it would add, one maintain, and one reduce.

Regional Presence and Integration of Activities

Geographically the survey results also are similar to the overall distribution of firms across Oregon and SW Washington. As shown in Exhibit 20 below, the majority of respondents (51.6%) were from Multnomah, Washington, and Clackamas Counties – 27.3%, 18.2% and 6.1% respectively. Another 15% were from Lane County and 9% from Marion County. The remaining firms were spread throughout Oregon and SW Washington; unfortunately only 1 company responded from SW Washington's Clark County so no geographic distinctions can be made with the survey results.

Exhibit 20: Location of Online Survey Respondents (Q22)



The 1998 Impresa study showed that there was a strong level of inter-industry integration within the metals manufacturing industry in Oregon, particularly between primary and fabricated metals. Our online survey asked several related questions to see if that was still the case. Overall, the survey participants indicated that about 48% of all suppliers were based in Oregon/SW Washington, with another 16% located in the Pacific Northwest, meaning that on average more than 64% of suppliers are regionally connected. From a customer perspective, on average 44% of customers were based in Oregon/SW Washington with another 17% based in the region, for a total of 61%.

The importance of the industrial eco-system between the respondents and their customers and suppliers was affirmed by another question in the survey. Companies were asked to identify the importance of a number of factors to keeping their business in Oregon or SW Washington. The most important factor, indicated to be 'extremely important' by 51% or companies was their customer relationships; a full 81% of companies said these were 'extremely' or 'very important'. Supplier relationships were 'extremely' or 'very important' to 69.8% of the companies. In fact, hiring and retaining labor and regional business costs were number two and three respectively for companies when 'extremely important' and 'very important' are combined. A total of 76.8% of companies said regional business costs was the number two benefit of this geographic location while slightly smaller 76.2% said hiring and retaining labor was the third most significant benefit.

For the business executives who participated in this survey, the regional cost of living and regional quality of life were particularly important. A total of 69% of respondents said that the regional quality of living was either 'extremely' or 'very important' while the regional cost of living was closely behind with more than 65% of answers recorded as 'extremely important' or 'very important'.

Of particular importance to the proposed NWCSM, the companies participating in the online survey did not rate the quality of community colleges or quality of universities as that important to their business location decisions. Despite indicating that employee attraction, skill development, and retention were important, only 16.3% of the companies said that the quality of universities was 'extremely important' while a smaller 11.6% said that the quality of community colleges was 'extremely important'. When 'extremely' and 'very important' responses are totaled together, the quality of universities and community colleges was highlighted by 35% and 32% of companies respectively.

External Industry Outreach and Engagement

The survey respondents are busy trying to keep their businesses afloat and it appears that a significant number have not joined any industry networks or professional associations to keep current with industry trends or activities. In fact, 42% of all respondents indicate that they have no industry network or association memberships. All of the transportation equipment manufacturers indicated that they were members of associations, as were 63% of machinery manufacturers, 56% of fabricated metal manufacturers, and 50% of primary metal processors.

Of those companies who are actively involved in associations, there was a wide range of associations noted including, in alphabetical order:

- Aircraft Kit Industry Association
- American Institute of Steel Construction (AISC)
- American Society of Mechanical Engineers (ASME)
- American Welding Society (AWS) IEEE
- Association for Manufacturing Excellence (AME)
- Association of Women in Metal Industries (AWMI)
- Constructions Specifications Institute (CSI)
- Door and Hardware Institute (DHI)
- Historic Preservation League of Oregon (HPLO)
- Job Growers
- Lean Manufacturing groups including NWHPEC and Mid-Willamette High Performance Consortium
- Metal Finishers Association (MFA)
- National Association of Home Builders (NAHB)
- National Federation of Independent Businesses (NFIB)
  Packaging Machinery Manufacturers Institute (PMMI)
- Northwest Tooling and Machining Association (NWTMA)
- Oregon Building Officials Association (OBOA)
- Pacific Northwest Fenton Association (PNWFA)
- Robotics Industries Association (RIA)
- Society of Plastic Engineers (SPE)
- Society of the Plastics Industry (SPI)

External University Outreach and Engagement

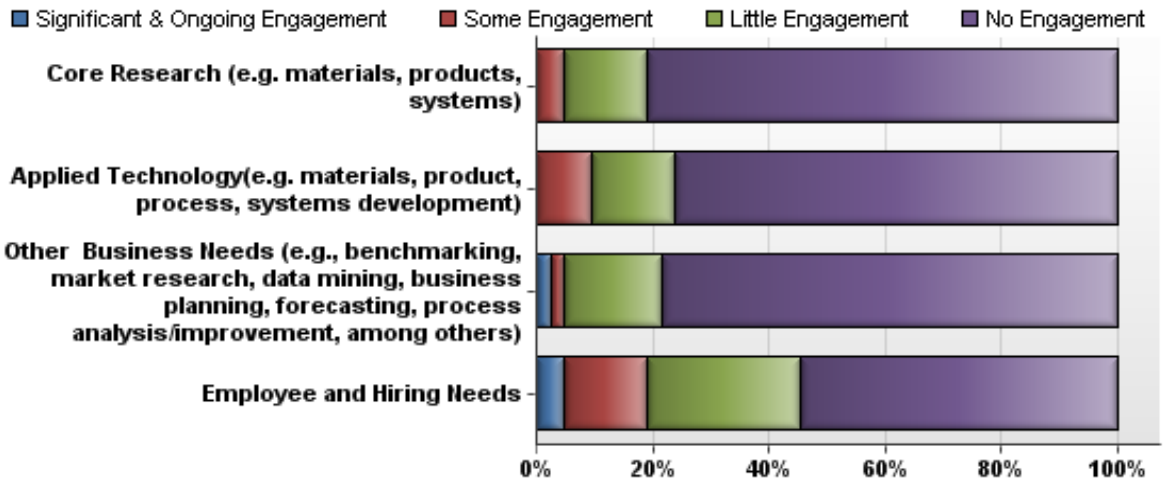
Since one of the most important areas of external outreach and engagement for the proposed NWCSM is with the university system in Oregon and SW Washington, the survey asked a number of questions about current levels of interaction with the university systems. In this area, the online respondents indicated that there was very little current or historic interaction.

Both from a current and historic perspective the companies were asked to identify in what areas they had engaged with universities at OSU, PSU, OIT, UO or WSU-Vancouver. Again, as shown in the following Exhibit 21, the metals manufacturing companies are not engaged with the university system today, nor have they been in the past in a significant and ongoing basis. In fact, the only area where there has been any notable engagement has been around employee and hiring needs, where a little more than 20% of the companies said they had previously had 'some engagement' or 'significant ongoing engagement'. This is entirely consistent with the indications from company management that one of their most important concerns is the human capital part of their business, in attracting and retaining employees.

Beyond employee and hiring needs, there is no pattern or predisposition to be engaged with

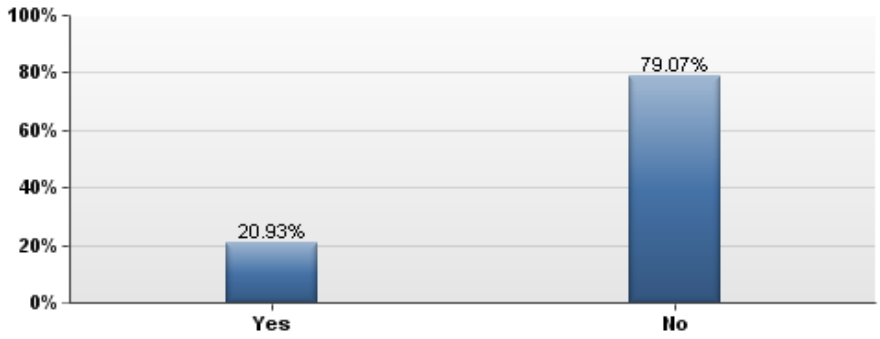
the university systems upon which NWCSM can build. In the area of applied technology, nearly 10% of companies did report some level of engagement, but nothing significant or ongoing. Similarly, in the area of core research on materials, products or systems, about 5% of companies had some engagement with the university system, but nothing on a significant or ongoing basis. Finally, in the area of other business support, which could include project support for business planning, process analysis, market research, a little more than 4% of companies indicated that they had some or significant ongoing engagement.

Exhibit 21: Contact with Local University or Community College in Last Year (Q12)



Overall 79% of companies had no contact with their local university or community college in the last year as shown in Exhibit 22 below.

Exhibit 22: Contact with Local University or Community College in Last Year (Q12)



Of the companies who had indicated that they had contact with a local community college or

university in the last year, 43% were in the fabricated metals product manufacturing sector, with the remaining companies drawn evenly from primary metal processing and machinery manufacturing. No transportation companies indicated that they had contact with the educational institutions in the last year.

One of our hypotheses going into the research is that we would see larger companies in the industry reach out to educational institutions on a regular basis. However, the research results do not prove this hypothesis out. Of the eight (8) firms who did have contact with local community colleges or universities, four (4) or 50% had annual revenues of less than $2.5 million, 2 or 25% with revenues between $5 and $20 million, and 2 or 25% with revenues in excess of $50 million per year.

The survey also asked those companies who indicated that they had contacted their local community college or university in the last year if they had been able to get the assistance they were looking for. One half of these firms replied 'yes', while the other half replied 'no'. One possible implication of this is that even when firms do think about reaching out to the university system, they do not necessary know who to call, how to navigate the academic institution networks, or how to access the right assistance within the timeframe that is of interest to them.

LESSONS LEARNED FROM OTHER COLLABORATORIES

Overview of Process

The connections between universities and industry have been studied extensively by academics over the last few decades. So this project included a review of this literature to see if it held any overall lessons or guidelines that should shape the structure, operations, or development of NWCSM. In addition, an important part of the project focused on studying the actual practices of other collaboratories and determining what elements of their structure, governance, operations and funding may be relevant to the NWCSM. Specific questions posed by MFG 21 and the PDC were:

- What are the organizational and financial best practices associated with the creation of similar entities around the world?
- What are the performance standards for similar centers and how should these be applied to measure effectiveness of the proposed model?

The primary research for this part of the project involved identifying forty two (42) programs around the world through online searches. After filtering out those programs that had little in common with the overall goals of the NWCSM, a smaller set of twenty-nine (29) were evaluated in more detail about the following:

- Organizational Mission
- Partners (educational, business, government, associations/other)
- Types of business support services provided
- Nature and structure of research (focus areas, types of projects, considerations of intellectual property)
- Faculty and student support
- Governance structure
- Organization infrastructure (revenue model, size of budget, full time staff, online presence)

As noted above, a set of twenty nine (29) collaboratories were evaluated.

- Out of these 29, twenty (20) were based in the US while nine (9) were housed abroad.
- Two (2) of the consortia studied were focused on the metals manufacturing industry, seven (7) focused on specific niches in the manufacturing sectors such as photovoltaics or composites, with the remaining twenty (20) having a broad manufacturing focus.
- Nineteen (19) of the consortia had a clear state or regional focus to their scope of work, ten (10) a national or country scope to their work.
- A list of the consortium evaluated is provided in Appendix G.

A preliminary analysis of best practices was developed and delivered to the client on September 5, 2012. The report discussed eight (8) specific areas of collaboratories:

- Scope of Industry Served and Services Offered
- Breadth and Balance of Network

- Industry Engagement
- Types of Research and Projects
- Faculty, Students and Workforce
- Structure
- Financial Commitments and Revenue Model
- Governance

This report should be reviewed for detailed information about the operations, governance structure, financing, and programs/services provided by each organization.

As a next step, contacts were made with twelve (12) of the collaboratories to set up and conduct interviews with the administration and to get follow-up questions answered so that the preliminary observations could be refined. Each of the twelve were contacted at least three times via telephone and email. Of the twelve five (5) indicated that they would be interested in setting up a time to talk, but eventually only four (4) of these participated:

- Advanced Manufacturing Research Centre (United Kingdom)
- Metal Processing Institute at Worcester Polytechnic Institute (Massachusetts)
- Direct Manufacturing Research Center, University Paderborn (Germany)
- Michigan Automation Alley (Michigan)

Based on further discussion with Michigan Automation Alley, it appears that this group is largely economic development focused with few substantive stakeholder relationships with educational institutions similar to that envisioned with NWCSM. The remaining three collaboratories all had relevant insights for NWCSM.

Guidance for NWCSM from Leading Collaboratories

What follows below is a summary of the preliminary findings and how these were refined by our subsequent conversations.

Industry Engagement

Many of the consortia we studied had demonstrated significant growth since their inception both in terms of industry involvement, service provision, and financial resources. Throughout it is clear that the most successful consortia are ones that make clear their value proposition to all stakeholders.

Most of the organizations we studied had an explicit industry outreach effort, and of these, most were open access. All could join and participate on a fee/membership basis. Only a few were selective and appeared to require firms to apply before they could participate. These tended to be the organizations that were actively involved in providing business advisory services to start-ups, in essence acting as incubators.

Stakeholder Commitment and Governance

Every organization that we reviewed received a strong push from a core set of stakeholders -- industry, education and government - to get the consortia off the ground. These founders formed the initial board of directors, ensuring that all stakeholders were represented. In terms of total size, the typical board of directors averages 12 members, with a high of 18 and a low of 7.

As the organizations have grown, most through a tiered membership model, the governance structure has been modified accordingly. Seats on advisory boards or boards of directors are held by the leading corporate members, those paying the largest membership fees, as well as academic and government stakeholders. However, as the membership ranks have continued to grow, particularly with smaller or medium-sized firms who are paying smaller membership fees, these same organizations provide spaces on the boards of directors for representatives from each tier of membership.

Many of the groups that we talked to in detail also identified the engagement of industry as a major focus of the administration. In fact, some of the collaboratories had set up additional committees that have a focused programmatic purpose tied to the mission of the organization, e.g. education/training, industry marketing, etc. Still others set up sector or issues oriented committees apart from the board itself, with the benefit of this approach being more industry and stakeholder involvement, and potentially thus more commitment to the growth and success of the institution.

A summary of the information about board size, structure, and overall stakeholder involvement from some of the most directly relevant consortia for NWCSM is presented in Exhibit 23 below.

Exhibit 23: Key Governance Features of Illustrative Collaboratories

Consortia	Board and Governance Structure	Other Industry and Stakeholder Engagement
Advanced Manufacturing Research Centre	• Board of Directors has eighteen (18) members • Tier 1 members each get a seat on the board • Tier 2 members get one member for all Tier 2 companies	
The Solar Energy Consortium	• Board of Director consists of fourteen (14) members, 3 from universities, 2 from organization and 9 from industry	
Center for Advanced Manufacturing Puget Sound	• 7 member Board of Directors • Charter members formed initial Board of Directors	

Consortia	Board and Governance Structure	Other Industry and Stakeholder Engagement
Direct Manufacturing Centre, University of Paderborn	• Fourteen (14) member Board of Directors, including members from each of the business members	
Bay Area Photovoltaic Consortium	• Executive Board runs the organization. 8 members, 4 from industry, the 2 co-directors, and 2 university reps from other than Stanford and UCB • DOE serves as an observer on the Industry Board and Executive Board	• Industry Board to identify research priorities, scope RFPs, review and rank proposals, reviews research progress • Industry Board is composed of all members who pay a fee at the Regular or Executive level • Participating Members are by invitation only and do not sit on Industry Board
Metal Processing Institute at Worcester Polytechnic Institute	• Each center has own by-laws covering governance, project selection and IP. o ACRC - 15 members. Executive Director, managing director and director-at-large permanent members. Other members serve term of two years with a six-on, six-off rotation of the membership each year. o CHTE - 7 members. Founding members formed start-up leadership, but moved off of Board of Directors after 2 years. o CR3 - Industrial Advisory Board (IAB) serve for a two year term.	• Each Project has a Focus Group made up of members interested in that project who serve to guide and review progress. Focus groups also look at economic impact of each project, work with staff member to publish a 1 page impact statement highlight, decide on public dissemination of results, put together review for upcoming meeting • Members of consortium select a director-at-large to advise research staff and steering committee • Representation from each member company assured through a rotational process
Commonwealth Center for Advanced Manufacturing	• Organizing Members have one voting member on the CCAM Board of Directors, the CCAM Industry Operations Board, and the Technical Advisory Council • Board of Directors has 11 members, 1 from each school and 8 from industry • Industrial Operations Board (IOB) provides oversight of operations, approves annual generic research funded in whole or in part by membership fees, reviews progress of research program • IOB has 12 members, one from each school and 9 from industry	• Technical Advisory Council (TAC) is an advisory board to the IOB charged with reviewing the research strategy of CCAM and providing feedback to the Executive Director on how the research strategy relates to broader research topics in the field of advanced manufacturing • TAC has 12 members, 3 from the schools and 9 from industry

Beyond those sitting on the board itself, these consortia are structured formally with clear by-laws, membership agreements, and well-structured boards of directors with finance, audit, executive and board development committees.

Financial Commitments and Revenue Model

To deliver value to a broader membership, the most successful organizations generally employed a tiered membership fee scale and clearly articulated on the website the benefits of the program to the member companies. A wide range of services were generally provided including news alerts, industry information, events/seminars, and a members only website portal that then supported networking within the industry and membership. Interactive and updated websites, along with a social media presence, are givens to be an effective presence and deliver content.

NWCSM will need to follow the example of leading collaboratories and set up a membership model for part of its revenues. Each of the groups that we studied also drew from an industry composed of large, medium and small-sized firms, similar to that in the Oregon and SW Washington region. Each employed a tiered membership model with membership benefits being scaled accordingly. There is a notable range in the membership fees, as shown below.

Exhibit 24: Membership Fees and Funding Mix for Illustrative Collaboratories

Consortia	Membership Level, Fees and Benefits	Other Start-Up Funding
Advanced Manufacturing Research Centre	• Tier 1 costs £200K per year; get seat on the Board and chance to chart research course. Tier 1 also may identify specific projects of interest as funds are available. • Tier 2 memberships cost £30K per year. Have access to all generic research as well.	• £15 million start-up funding partnership with Boeing, European Regional Development Fund and Yorkshire Forward
Western Michigan's Green Manufacturing Industrial Consortium	• Industry Full Membership (which includes a seat on the Advisory Committee) is $25,000 per year	• $1 million in federal DOE funds to start up and establish the Manufacturing Research Center
Center for Advanced Manufacturing Puget Sound	• Memberships with ranges from $750 to $3500 per company, scaled by size of firm	• $650,000 in start-up funding from US Economic Development Administration, City of Kent, Washington State CTED, Port of Seattle, and private funds

Consortia	Membership Level, Fees and Benefits	Other Start-Up Funding
Direct Manufacturing Centre, University of Paderborn	• Tier 1 memberships are 100K Euros per year • Tier 2 members pay 50K Euros per year	• The state of NRW funds up to 3.4 million Euros matched to industry money
Commonwealth Center for Advanced Manufacturing (CCAM)	• Organizing Members and Tier1 Members pay $400K per year in fees • Tier 2 Members pay $100K per year. Tier 2 Members participate in generic research and have non-exclusive royalty free rights to results while a member • All members commit to a minimum of five years of membership	
Metal Processing Institute at Worcester Polytechnic Institute	• Three different centers have different annual membership dues: o ACRC - $17,500 per year o CHTE - $25,000 per year for founding members and then scales by membership category to $2K per year. o CR3 - $30,000 per year • CHTE has all membership classes except Bronze eligible to use the IP resulting from research; Bronze members can participate in symposia and educational events, but not participate directly in research projects.	• Federal agency and foundation grants
Bay Area Photovoltaic Consortium	• Membership fee with multiple levels of membership from Executive ($200K per year), Regular ($50K per year), Participating ($10K per year) • Participating Members are by invitation only	• US Department of Energy is providing $25 million over five years (2011-2016) as part of the SunShot Photovoltaic Manufacturing Initiative

One of the common themes among the collaboratories we communicated with was their insistence that membership fees had to be set in a way that was substantial enough to help support the organization, but that recognized the ability to pay difference between smaller, medium-sized and large firms. In fact, the management of the University of Paderborn summarized it quite clearly:

> *"A $100,000 commitment coming from a large company is really just an allocation of some of its internal research budget. For smaller firms, who don't have this kind of internal R&D effort, this is a more significant investment and one that management of the company will take really seriously before they join us. However, the key for these smaller firms is that they understand that the value proposition of their*

own $50,000 investment is that it gets leveraged by everyone else's investment."

From a start-up perspective the most successful collaboratories indicated that they had received multi-year start up commitments from a number of industry players in their region that had helped sustain the organization as it was established and as it began to build connections out through the region, with education, and with associations or other industry networked groups.

Firms that focus on incubator and early stage commercialization of businesses do appear to receive some grant and government funding. As will be discussed later, they may also receive some form of royalty payments for intellectual property developed through shared research consortia projects. Those that focus on supporting existing businesses typically rely more on memberships, event fees, and even online advertising and sponsorships from companies or service providers that want to reach industry members.

Scope of Industry Served and Services Offered

The proposed NWCSM has been discussed as having a core focus on the metals manufacturing industry in the region. Having a clear focused industry sector is also how other successful consortia have started. Over time, however, this focus has evolved to incorporate the industrial eco-system of the cluster, so that customers and suppliers of the focal industry are included. At the same time industry challenges have continued to broaden the scope of the issues addressed by the collaborator. Thus, several of the consortia that we talked to in more detail indicated that the initial metals focus that they started with was moving towards more of an advanced manufacturing focus, not metals exclusively.

Every leading collaboratory that was examined is industrially led throughout all of its aspects -- governance, programs and funding. This is particularly important since, as discussed above, the organizations have a strong membership model that entails the development and retention of industry members. Thus, the set of services offered to industry is shaped by what is most important to the industry. The AMRC interview discussed this tension explicitly:

> *"The AMRC is always industrially led – areas of research are driven by our industrial partners through the board…. Academics wish to publish and share, our industrial partners wish to protect advantage and exploit benefits through their global supply chains, and the government wishes everything to happen in our local region! We always take the lead from our industrial partners – industry pull, not technology push or academic push."*

The consortia most similar to the vision of NWCSM focus programs largely on engineering, technology and even early stage commercialization. There does appear to be some form of project level support for issues around operations, sustainability, business planning, marketing, research, and operations yet this has evolved over time. These were not the primary issues that had generated the industry consensus to come together initially.

Types of Research and Projects

Right now most of the university-industry linkage in Oregon and SW Washington gets done successfully through the one-on-one projects offered through the Oregon Metals Initiative. Most of these projects to date are applied engineering focused. Successful consortia use this same model of company specific chartered projects, again largely with an applied engineering focus, but also complement these with collaborative/shared efforts among industry partners on either applied engineering or basic pre-competitive research. Only a few have evolved to sponsor their own in-house basic research.

Most of the successful consortia we examined have focused their project and research efforts using a model similar to that shown below in Exhibit 25. This Manufacturing Readiness Level (MRL) model is nearly identical to that the Technology Readiness Level (TRL) assessment used by the AMRC who identified that the gap within its target industry was applied research from levels 3-7. Thus arose the AMRC's overall growth strategy of *"taking ideas and concepts and proving them in a manufacturing environment, making technologies ready for adoption by manufacturing companies".*

Exhibit 25: Picking a Focal Area for Projects and Research

Manufacturing Readiness Level (MRL)		
Phase	MRL	State of Development
Phase 3: Production Implementation	9	Full production process qualified for full range of parts and full metrics achieved
	8	Full production process qualified for full range of parts
	7	Capability and rate confirmed
Phase 2: Pre production	6	Process optimised for production rate on production equipment
	5	Basic capability demonstrated
Phase 1: Technology assessment and proving	4	Production validated in lab environment
	3	Experimental proof of concept completed
	2	Application and validity of concept validated or demonstrated
	1	Concept proposed with scientific validation

Source: University of Sheffield, AMRC

For example, at the Advanced Manufacturing Research Centre (AMRC) in the United Kingdom, there are three kinds of projects undertaken:

- *"Generic research carried out on behalf of the AMRC partnership, with results distributed to all partners. Generic projects are agreed by the board of members, and results are shared between all members."*
- "*Specific research for individual partners. The partner invests directly in the research and has exclusive access to any resulting intellectual property." Non-members can also commission specific projects.*
- "*Innovative projects carried out on behalf of the partnership, with results presented to all partners. These projects are usually funded by EPSRC, the European Framework Programme, or other external body, and may involve collaboration with external research and industrial partners."*

An interesting addendum to the AMRC's definition of research above was provided by one of its staff in follow-up conversations. *"In reality, we very rarely develop IP in our projects. Very often the concepts, products and processes are already protected before we get involved. Any IP that arises is shared across those involved in the project."*

The area of research represents one of the major tensions within the working of these consortia. Academic researchers by nature want to conduct research and then publish its results. However, commercial entities, particularly the sponsors of the research, understandably want to ensure that they have access to the results and are able to translate this into market applications before competitors. How the consortia handle this differs. Some consortia explicitly acknowledge this tension and put a time limit on the period by which research results are kept out of the public domain. Still others have a time limit, but also indicate that the research can be published, subject to a review by an established committee. We believe that this latter procedure provides the best balance between the interests of academics and industry.

Another one of the core best practices we have identified relates to the way that consortia involve members in the actual conducting of research itself. The management of consortia with whom we communicated all emphasized that the selection of the projects is an essential way of delivering value to members, and thus the selection needs to try to make sure that issues of interest to a majority of members were included. Several spoke of the large company-small company tension in this area and noted that since many of the members were smaller and medium sized, it was necessary not only to make sure there was representation on the board, as discussed above, but that the projects and research being worked on was of interest and potential value as well. The Director of Operations at WPI's Metal Processing Institute also noted that

> *"Getting these smaller and medium-sized firms to have an interest in the projects is key so they get vested in the organization early. We spend lots of time recruiting them to join. We don't want to lose them."*

Similarly, the AMRC representative noted that findings projects that are of interest to small and medium sized firms was essential to its larger members as well:

> *"Many of our partner companies are small and medium firms. We find that many of them look to the larger organizations for trends in materials, processes and manufacturing technology. Many of the answers to our larger partner's problems come from small to medium companies, and many of them have increased sales or won new business as a result of collaboration. We engage with many small companies outside the partnership too – they represent the supply chain of larger partners."*

There are a few consortia that explicitly build into research and projects undertaken both a scientific and industry/commercial oversight function. At least one publicly noted that it assigns an industry mentor to each project to ensure that the commercial applications of the research are clearly incorporated into the work plans. Still another noted that it requests project partners to dedicate or donate time, equipment or space, to support the project teams.

For those organizations who engage in pre-competitive research, they have incorporated into their membership agreements and by-laws provisions for sharing the results of the research with members, allowing non-exclusive royalty-free use of results for members, and for sharing any related revenue from the intellectual property resulting from the research itself. The level of detail on the websites vary, with some organizations posting by-laws and membership agreements that spell out in great specificity how this all works. Others just make mention and indicate that this is provided as part of the membership application process.

Exhibit 26 on the next page summarizes some of the more interesting project related provisions of the consortia studied.

Exhibit 26: Selected Provisions on Project Licensing or Commercialization

Consortia	Commercialization, Licensing and IP	Publishing of Results
Sirris	• Shared R&D by a set of partners to develop technologies at a precompetitive stage where costs and risks are shared between partners • IP for innovation support efforts remains with the client company • IP for shared projects stays within the project consortium	Sirris
EWI Additive Consortium	• Works on precompetitive research • Indicates that it conducts "translational research" that has a significant commercial impact in next 2-5 years	• 2 year moratorium on making AMC information public • Members receive a royalty-free license to AMC intellectual property

Consortia	Commercialization, Licensing and IP	Publishing of Results
Western Michigan's Green Manufacturing Industrial Consortium (GMIC)	• Any invention created, conceived or developed as a result of work done in connection with a Project is owned jointly by those GMIC Members in the GMIC when the invention was created, conceived or developed • Each GMIC member has a perpetual, non-exclusive, non-assignable, royalty free right to use the invention under any intellectual property rights granted on the invention • Any GMIC member that withdraws has no ownership interest in the IP that is developed by the GMIC after it has withdrawn • For five (5) years thereafter, the GMIC Members shall try to prevent disclosure to others of Confidential Information	• Scholarly publications are allowing with the proper masking of specific data; publications are to be submitted to the Advisory Committee prior to submissions or disclosure
Metal Processing Institute at Worcester Polytechnic Institute	• For IP resulting from ACRC funded research, the ACRC Steering Committee, will determine if it has an interest in obtaining a particular patent or copyright. If the ACRC membership has an interest in a particular invention, WPI will proceed with the filing of any patents or copyrights. • WPI is owner of the intellectual property. • Royalties go 50% to the inventors and 50% to the WPI center.	• Publication in public domain will take place after a period of no less than one year for information deemed to have commercial value to members • Proprietary research for a member company is protected by a non-disclosure • Each Project has a Focus Group who guides and reviews progress, looks at economic impact of each project, works with staff to publish a 1 page impact statement highlight, decides on dissemination of results, puts together review for upcoming meeting
Bay Area Photovoltaic Consortium	• Consortium seeks out research proposals nationally and awards them in rounds to Principal Investigators once or twice a year • Industry Board serves as the group to identify research priorities, scope RFPs, review and rank proposals, reviews research progress	• Members have first access to all inventions • Inventions are owned by the host institutions of the researchers • Research is published in the public domain, but not clear when or what restrictions may be placed on the publication • Members may negotiate non-exclusive royalty licenses to IP

Consortia	Commercialization, Licensing and IP	Publishing of Results
Commonwealth Center for Advanced Manufacturing (CCAM)	• All CCAM members have access to the results of research defined as "generic" • Organizing and Tier1 members can also have directed research that involves projects of specific interest to the member • Tier 2 Members participate in generic research and have non-exclusive royalty free rights to results while a member	
Direct Manufacturing Centre, University of Paderborn	• Most projects currently are of interest to a majority of members, not company specific • There are two leaders on every project – a scientific/industry and an academic with a project manager selected from the industry membership pool	• Partners are included in pre-publication reviews

Breadth and Balance of Network

As noted above, the consortia most similar to that envisioned by NWCSM have built a strong university-industry linkage into the services offered, governance structure, and value proposition. And because they are largely industry driven, these organizations also expend substantial time to build active and collaborative links with governmental organizations, industry associations and economic development organizations from the area. In essence, the most effective consortia are ones that establish themselves as a connector between industry, related associations and centers, and educational entities. These consortia understand that the needs of industry often have to be translated and filtered to get the best responses in the quickest fashion. Staff see and characterize themselves as "concierges". As the Director of Operations at WPI's Metal Processing Institute said,

> *"We are 'on call'. We are a 'concierge' to our member companies for one time projects a company might have a need to do, internships, connections out to other organizations, sources of information, you name it. We are driven to serve their needs, and in doing so understand better what their needs are."*

Faculty and Students

As the most successful consortia have evolved, so too has the nature and size of faculty and students involved. Nearly every organization we communicated with indicated that their academic strategy had been to identify a "coalition of the willing", of faculty who were interested in the work of the consortia and with whom the project topics had a natural fit with their research interests. What this means from a staffing and organizational development perspective is not only must the collaborator know and make connections with associations and other industry groups, but it must also spend time developing a robust and engaged faculty

network – both from the participating institutions as well as from elsewhere as needed to fill gaps. In fact, the AMRC contact indicated that *"our knowledge of their (faculty) skill set gives us the knowledge of a 'first port of call' for expertise or equipment."* At the University of Paderborn a similar effort was undertaken to identify core faculty who would start up the organization, but since then the number of faculty has grown to about 15 researchers in total, with 8-9 being drawn from the academic ranks.

From a student perspective, several of the consortia appear to have a directed focus on providing graduate and post-doctoral students the opportunity to work with industry on the specific research projects. The opportunity to offer graduate students these projects is an important component to attracting more and better students – similar to the ways that the Oregon Metals Initiative has successfully resulted in supporting a number of graduate students for their course of study at Oregon State University.

Internships and career opportunities for students are a key thrust of most successful consortia, largely because the industry as a whole continues to identify human capital and resource development as a critical issue. A few programs call attention to their efforts to provide career services support to industry through the posting and marketing of internships and full time job openings as well as doing some internship matching.

As noted above, most of the project related work in the consortia studied revolves around engineering and technology issues. As member companies have posed issues or developed project requests for work in commercial, planning, marketing and/or operational aspects of industry, opportunities to engage faculty and/or students in experiential learning projects are addressed on an as needed basis.

Structure

Starting up a collaboratory does not mean setting up a large and separate staff. Most of the groups we communicated with indicated that of necessity their staff complement is kept as lean and flat as possible. Experts are brought in to supplement staff as needed, but the full blown complement of staff is typically between 3-5 people. Thus, overhead is kept as low as possible and information services are increasingly delivered in a virtual way. As shown in Exhibit 27 below, data from a sample of the companies we examined bear out this conclusion:

Exhibit 27: Illustrative Staffing Levels

Consortia	Full Time Staff Noted on Website	Key Management Positions
Metal Processing Institute at Worcester Polytechnic Institute	• Five full time staff	• Director • Director of Operations • Asst. Director of Operations • Information Systems
Advanced Manufacturing Research Centre (AMRC)	• Three	• Research Director • Commercial Director • Projects Director
Center for Advanced Manufacturing Puget Sound	• Three full time staff	• Executive Director • Business Development Manager • Project Manager
Commonwealth Center for Advanced Manufacturing (CCAM)	• Six	• Executive Director • Director of Operations • Manager of Administration • Project Leaders (3)
Advanced Manufacturing Institute (AMI), Kansas State University	• Five	• Director • Associate Director • Chief Engineer • Business Manager • Marketing/ Communications Manager

Guidance for NWCSM from Academic Research

As noted in the introduction to this section of the report, the project team not only looked at the way that actual collaboratories were working today in order to develop some lessons for the proposed NWCSM, but also reviewed some of the academic literature written over the last decade on the topic of successful university-industry partnerships. Again the goals of this academic literature review were to:

- Identify any best practices in university-industry linkages that have been studied by academics in terms of keys to success, structure, performance measurement, incentives, or stakeholder engagement
- Develop ideas for frameworks by which to formalize recommendations for NWSCM

Many of the papers studying this issue were addressing changes in the larger business environment that came about due to changing legislative provisions, such as the Bayh-Dole Act of 1980 which changed the rules governing university management of intellectual property and the National Cooperative Research Act of 1984 which outlined incentives for firms to engage in joint ventures around R&D. Many of the papers focused on the effective operations of commercialization and licensing through technology transfer offices (TTOs) within universities, but these are less helpful since it is not at all clear to what extent NWCSM will be engaged in pre-competitive and basic research within the first few years of its life.

A full list of the papers reviewed is contained in the bibliography at the end of this paper, but some of the most relevant points for the proposed NWCSM are summarized below.

Geographic Scope

NWCSM is focused on supporting the metals manufacturing industry within a targeted geographic market. The authors Siegel, Wright and Lockett[3] point out that "mid-range" universities face a tension trying to get a critical mass and develop centers of research excellence – and then also trying to work with industry and the local economy.

- Using an industry focused market segmentation approach similar to that envisioned by NWCSM may be the best way to go because it finds and then builds a set of expertise that both large and smaller firms would want to access for specific industry clusters.
- However, the researchers point out that larger firms are mobile in their search for expertise; they can look and get expertise from many places – even out of the region – for more specialized questions and issues.
- To succeed in these areas the authors mention that universities in more mature regions or ones facing economic slowdown will have other issues to face, including an increase in graduate mobility out of the region and/or the need to develop new programs or areas of expertise to match emerging needs.

Nature of Research

Earlier we discussed the nature of industry memberships and the need for NWCSM to develop a value proposition that was relevant to companies – of all sizes. We also discussed the need to develop a commitment to fund the collaboratory through membership fees. What this means, however, is that organizations need to be cognizant of what levels of research are already being done in companies and how the organization's project work may be complementary to internal efforts. Academic research has some conclusions in this area.

When studies are done on university-industry linkages much of it has revolved around the actual nature of the work being done and how this work either complements or substitutes for in-house work. One of the most interesting studies we found that we believe is relevant to the proposed NWCSM was done by Bramwell and Wolfe[4]. These two authors delve into the nature of what research industry already does and conclude that

> *"Though most firms are engaged in R&D to some extent, they are typically much more focused on product development than primary research. The current trend in the innovation process among local firms is predominantly solutions -focused, incremental innovations, rather than research-intensive, first generation innovations. Product and process improvements are intended to make the product*

[3] Siegel, Donald, Mike Wright and Andy Lockett, "The Rise of Entrepreneurial Activity at Universities: Organizational and Societal Implications", Industrial and Corporate Change, Volume 16, Number 4, p. 489-504. 2007.

[4] Bramwell, Allison and David Wolfe, "Universities and Regional Economic Development: The Entrepreneurial University of Waterloo", Research Policy, Volume 37, p. 1175-1187, 2008.

'faster, smaller, cheaper'....This emphasis on performance improvement and fine-tuning reflects the trends what one observed describes as 'little R, big D' projects."

The results of the industry online, in-person and telephone interviews discussed in the previous section confirm that in the case of the metals manufacturing industry in Oregon and SW Washington the overwhelming concern is on "little R, big D" issues, on building the capabilities to be more effective competitors in the marketplace by addressing technology, engineering, and operational issues that are largely incremental, not leading edge disruptions.

Some of the econometric work done by Link, Paton and Siegel[5] demonstrated that formal collaborative research projects often act as a substitute for internal basic research projects, that is firms who do not have active internal basic research projects may be drawn to participate in collaborative efforts. The authors also found that investments in these programs is typically pro-cyclical, e.g. when the economy is strong firms will finance collaborative work. (The hypothesis that was disproven was that participation would be counter-cyclical in that own company R&D investments would be weaker when the economy was weak and more collaborative efforts would be made to generate new knowledge.)

Another interesting observation of Bramwell and Wolfe that corresponds to the work by Link et al is that firms who benefit from university-industry linkages need to have their own internal capacity for research in order to really participate effectively. The consortia or university linkage cannot be a complete substitute. "A key implication of this is that firms require a strong contingent of highly qualified research scientists and engineers ... to maintain an internal ability to assess and absorb scientific knowledge." The implication for NWCSM is clear. What will be the organization's value proposition and how will it resound with those who have the internal capability to act upon it and translate it into their own competitive strategies?

The authors Perkmann and Salter[6] have looked at the need to build a longer term relationship with universities and then balanced that with the need to sometimes do proprietary work and other times be open to shared work. They propose that there are really four models of partnership that can be defined:

- *"The Idea Lab, where managers put aside their desire for secrecy and work with academics to create new options and contacts.*
- *The grand challenge, where managers and academics work together to create a new knowledge base that will be shared in the public domain.*
- *The extended workbench, where managers work rapidly with university partners on proprietary problems and solutions.*
- *Deep exploration, where the company creates rich and long-lasting relationships with university partners that, in turn, offer the business rights of first refusal to license collaboration results."*

[5] Link, Albert, David Paton and Donald Siegel, "An Econometric Analysis of Trends in Research Joint Venture Activity", Managerial and Decision Economics, Volume 26, pages 149-158, 2005

[6] Perkmann, Markus and Ammon Salter, :How to Create Productive Partnerships with Universities", MIT Sloan Management Review, Volume 53, Number 4, p.79+ , Summer 2012.

Of these four, it is the "extended workbench" and "deep exploration" which are the two areas where we see the most potential fit between the aspirations for NWCSM and its academic and industry partners over the next few years.

Performance Measurement

A good deal of the literature around university-industry linkages discusses the measures of outcomes that can be used to assess the success of these ventures. Among the many papers we reviewed, most notably ones by Santoro[7] and McAdam[8], a consensus seems to be that success can and should be measured using the following indicators:

- **Academic Output:** Number of research papers published, number of papers presented at professional conferences, number of master theses and doctoral dissertations, level of co-authoring of papers, number of academics involved, number of academic disciplines involved
- **Industry Engagement:** Number of members by industry cluster or target size, percentage of members renewing, number of new members referred by existing members, program participation, number of companies represented on advisory boards
- **Project Effectiveness:** Projects completed on time, project spending vs. budget
- **Technology Transfer, Commercialization and Intellectual Property**: Number of patents/patent applications/licenses, dollar value of royalties or licensing fees, number of spin-outs
- **Research Leverage:** Amount of funding obtained, increase in number of sources of funding, amount of industry money matched by university or public sources
- **Human Capital:** Number of graduate students supported by industry projects, number of students completing internships in the industry, number of new hires from previous interns

Interestingly many of these same indicators were mentioned by the benchmarked collaboratories with whom we interacted as part of this project.

[7] Santoro, Michael, "Success Breeds Success: The Linkage Between Relationship Intensity and Tangible Outcomes in Industry-University Collaborative Ventures", The Journal of High Technology Management Research, Volume 11, Number 2, pages 255-273, 2000.

[8] McAdam, Rodney, Kristel Miller, Maura McAdam, and Sinead Teague, " The Development of University Technology Transfer Stakeholder Relationships at a Regional Level: Lessons for the Future", Technovation, Volume 32, p. 57-67, 2012.

Conclusions

Out of all of the secondary research done on academic studies and website reviews of collaboratories, as well as the invaluable primary interviews and communications with a selected number of collaboratories, a number of critical success factors or "best practices" have emerged to guide the development of the NWCSM. Successful collaboratories must:

- Have a clear and focused strategic value proposition that resonates with industry members, complements their business concerns, and results in their willingness to make a financial commitment to the organization
- Recognize the various interests of each partner and unite these into a mission that fosters appreciation of each stakeholder
- Match projects with academic, scientific and commercial resources and input so that expectations are discussed upfront and managed throughout the life of a project
- Structure operations and agreements to be flexible, sensitive to the timetables of business, and ensure timely completion of activities
- Hire staff who can build networks, understand business needs, discern where there are academic or university capabilities that match these needs, and develop mechanisms by which the two parties are brought together in a collaborative fashion
- Build linkages outside of the region and the focal industry cluster where it is appropriate

ENGAGING THE REGION'S GOVERNMENT AND EDUCATIONAL INSTITUTIONS

Overview of the Process

The proposed NWCSM has an important set of stakeholders in the governmental organizations in Oregon and SW Washington as well as the educational institutions in the region. Moreover, as was noted in the study of best practices in successful collaboratories, those groups who have continued to grow have done so by carefully starting out with a "coalition of the willing" from the academic institutions and then building upon it as projects are successfully completed and research is produced.

As part of the project therefore, a separate strand of research was completed to discuss the proposed NWCSM with members of governmental organizations and educational institutions. The primary research for this part of the project involved conducting telephone, in-person or email interviews with thirty eight (38) members of the faculty as well as deans at the following universities: Oregon Institute of Technology, Oregon State University, Portland State University, University of Oregon, and Washington State University - Vancouver. Appendix H lists the interviewees from the educational stakeholders.

Finally, as part of this part of the project nine (9) interviews were done with members of key associations or groups within Oregon and SW Washington with which the proposed NWCSM would need to work. (Appendix I has the list of interviewees.) The intent of these interviews was twofold:

- See where they see NWCSM fitting into the needs of their members or filling a gap with their own services
- Understand the way that these organizations already link into the OUS and the nature of previous experiences with linking into the educational systems.

Findings

Below are some key observations from faculty interviews:

- Several faculty recognize the potential benefit of cross-university collaboration but have not personally engaged across schools in the region
- Faculty participation is driven by industry “fit” to their own research
- Faculty have significant interest in seeking industry grants
- Industry engagement is more attractive as a primary research agenda to applied and non-tenure track research faculty. OMI is a major entity that funds significant research for metals manufacturing.
- Leadership across OUS and WSU-V is supportive but many faculty across schools in NWCSM have not yet perceived it to be a strategic priority at their respective schools.

Overall Academic Interest and Engagement with NWCSM

After we conducted a wide range of interviews across the various educational institutions in the region, we worked to integrate these into an overall assessment of the level of academic interest and engagement at the various schools who might participate in NWCSM. We not only tried to distinguish this interest in terms of intensity (from highly interested/champion of the idea to interested/not yet engaged) but also by the academic discipline and by the type of faculty (academic tenure track researchers, applied faculty, non-tenure track or administration).

Our summary results are presented in Exhibit 28.

Exhibit 28: Academic Interest and Engagement Classification

School	Highly Interested/ Champion	Interested/ Engaged	Interested/ Not Engaged Yet
OSU	• 1 Applied (Mech. Engineering), NTT Research	• 3-4 Academic Researchers (Mechanical, industrial, mfg. engineering) • 1 Academic Researcher (Business)	• Dean (new)
PSU	• 1 Academic/Applied Researcher (Mechanical and Materials Engineering) • Dean	• 1 Academic (Bus) • 1 Academic Research (Mechanical and Materials Engineering)	
OIT	• Dean		• 3 Applied (Metals, Engineering) • Dean
UO (LCB)	• 1 Academic Researcher with extensive applied work (Supply Chain, Operations) • 1 Center Director (Sustainability)	• Dean • 1-2 Academic Researchers (Supply Chain, Operations, Innovation)	• 3-5 Academic Researchers (Marketing, Industrial Ecology, Sustainability) • 2 Program Directors (Entrepreneurship, Innovation)
WSUV	• Director of Research	• 1 -2 Academic Researchers with extensive applied experience (Metals, Composites)	

Building a Network With Industry Associations

Very few of the associations with whom we spoke currently have extensive dealings with the universities in the area. Nor did they indicate that they had heard a lot of conversation looking for support in the area of engineering or technology. At the same time, however, most of the interviewees indicated that they work hard to keep their own programs focused and issues like applied engineering projects would not likely come across their desk. From a macro-perspective of the industry these same individuals did believe that increased attention on value added manufacturing, digital manufacturing, automation, robotics, and new materials or materials sciences were indeed issues that the industry needed to address.

The association interviewees confirmed that the biggest issues their own members continue to focus on is its workforce development and organizational training, particularly in smaller and medium-sized firms

The associations interviewed consistently indicate that the idea of the collaboratory might be attractive, but only if it was structured to provide an easy to use experience for companies who want to tap into OUS faculty, student or career services resources. And even beyond that, the resources that companies needed to tap into were ones that should be focused on industry issues, preferably even being run by a former member of the industry itself to give the effort credibility.

While the overall idea of the NWCSM met with some positive response, members of these associations were also cautious about the level of support that the program might get in the next few years, particularly as the local economy continues to recover. Indeed, nearly all of these organizations reported that they had seen a shift in willingness to pay and participate in their own activities over the last few years. Most indicated that overall membership had declined and that groups had been responding with changed payment plans, better benefits, or higher quality programs to get members to stay involved. Several mentioned that they had seen companies choose which organization to belong to if the value propositions seemed like they were duplicative.

Guidance from Academic Research

As noted in the introduction to this section of the report, some of the academic literature written about university-industry linkages also discussed the nature and types of faculty engagement that would help make collaboratories successful. This work confirms the guidance provided by the most successful collaboratories to recognize that the faculty who should be involved with the NWCSM are the ones who want to be involved, who show a particular interest in working with and learning from industry in a collaborative fashion. Not all faculty want to, or are even good at, doing this kind of work.

So who are the faculty most likely to be interested in a consortia similar to that being discussed for NWCSM? The fact that NWCSM is likely to draw from engineering faculty bodes well since many studies show that this discipline already demonstrates a predisposition to work with

industry. A summary of some of the key points from this literature search is provided below.

- Link, Siegel, Bozeman[9] looked at career paths of scientists and engineers at US university research centers and concluded that the career paths of these academics have marked ties between universities and industry. They also showed, not surprisingly, that tenured faculty members are more likely than untenured faculty to engage in informal technology transfers (working as a formal paid consultant, co-authoring a paper with industry personnel, or working directly with industry to transfer/commercialize/apply research). This same study showed that the faculty most likely to engage with industry are those who have higher percentages of their time in grants-related research.
- D'Este and Fontana[10] did a really interesting study to look at how different academic faculty members worked with their peers or with industry, how they set up their networks, and how they chose different partners. They found that most academic researchers typically interact with few partners. However, Engineering faculty typically have 4.26 organizational partners per researcher and 3.72 company partners, above the study average in both categories. Engineering academics have the second highest degree of working with a company partner; second only to architecture.
- Related to the idea that faculty who are typically tenured are more likely to engage in this kind of work, Poyago et al[11] mention the often raised concern that university-industry partnerships may result in a shift from basic to applied research, thereby causing longer term harm to academics, but they point out that there have been some studies that show that this is not the case, that technology transfer does not reduce the quantity or quality of basic research. Siegel, Wright and Lockett[12] also confirms this

  "Engagement in entrepreneurial activities coincides with increased publication outputs, without affecting the nature of the publications involved. Lowe and Gonzalez-Brambila (2007) find that faculty entrepreneurs are among the most productive and best-cited in their respective fields....However, they note a differential discipline effect with faculty entrepreneurs in engineering experience a more positive effect on research productivity than academics in chemistry and biomedicine."

Conclusions

[9] Link, Albert, Donald Siegel and Barry Bozeman, "An Empirical Analysis of the Propensity of Academics to Engage in Informal University Technology Transfer", Industrial and Corporate Change, Volume 16, Number 4, p. 641-655, 2007.

[10] D'Este, Pablo and Roberto Fontana, "What Drives the Emergence of Entrepreneurial Academics? A Study on Collaborative Research Partnerships in the UK", Research Evaluation, Volume 16, Number 4, pages 257-270, December 2007

[11] Poyago-Theotoky, Joanna, John Beath, Donald S. Siegel, "Universities and Fundamental Research: Reflections on the Growth of University-Industry Partnerships", Oxford Review of Economic Policy, Volume 18, Number 1, 2002.

[12] Siegel, Donald, Mike Wright and Andy Lockett, "The Rise of Entrepreneurial Activity at Universities: Organizational and Societal Implications", Industrial and Corporate Change, Volume 16, Number 4, p. 489-504. 2007

There is heightened interest amongst a critical mass of key stakeholders in NWCSM to make this happen. It is also clear that much work needs to be done to continue to increase the awareness of the NWCSM initiative across the eco-system, hone the value proposition, and bring all key stakeholders to the table. While much of the focus of NWCSM is to offer the metals manufacturing eco-system in the region the ability to tap into the research and education capacity at the universities, the universities by themselves currently don't have a mechanism or infrastructure to facilitate this interaction in a strategic, collaborative, and purposeful manner. There is a large gap in the number of faculty that can actively support the needs of the metals industry, particularly at the scale that is being envisioned in NWCSM. A strategic partnership needs to evolve between universities, industry, and economic development entities in the region to develop a suitable governance mechanism and muster the requisite resources and support.

The Oregon Metals Initiative is by far the most organized entity that currently facilitates the interaction with engineering schools at OSU and PSU to undertake applied and more near term research for metals-based firms. These interactions are largely concentrated with a few key faculty members interested in more applied research. OIT and WSU-V are currently not engaged in the research funded by Oregon Metals Initiative. There is a significant risk to this capacity with one of the highly engaged faculty member at PSU being close to retirement. Oregon Metals Initiative currently does not have any mechanisms to facilitate the governance and coordination that is needed to scale the scope of engagement as envisioned for the collaboratory. The current annual budget of OMI is also a fraction of the budget being envisioned for NWCSM. NWCSM must actively engage with OMI to find a mechanism to collaborate and integrate.

The industry still needs to offer significantly greater clarity on the scope of medium and longer term research that can be undertaken by the universities. The research universities are typically more focused on building the capacity for cutting edge research (i.e., newer materials and product/process technologies) by hiring tenure track faculty that are expected to focus on more long term challenges and publish in high quality academic journals. The focus on metals research is a significantly small part of the focus across OUS schools. The universities need to see a compelling need in research and education to scale their portfolio of tenure track capacity and non-tenure track research faculty to support the needs of the metals industry in the region. The universities also need to see the requisite level of resources to make these long term investments in faculty, equipment, and other infrastructure. Ultimately, there needs to be a compelling vision for NWCSM, with value proposition that is clear to all stakeholders across the eco-system. Unlike many university or industry driven initiatives, this initiative will need a more organic partnership between universities, industry, and economic development entities in the region wherein NWCSM provides a suitable (largely virtual) governance mechanism to facilitate these collaborations in the eco-system. At this stage it also appears that much of the investments for NWCSM will need to come from State and Federal funds with industry in the region also contributing a fair share. The universities too will have to make a strategic shift in their approach to building research capacity, wherein the portfolio of non-tenure track research faculty is also a significant part of the capacity to support the needs of the industry in the

region. At the same time, the long term success of NWCSM rests on the holistic ability to tap non-tenure track faculty (NTTF) for more applied and near term research and both NTTF and tenure track faculty for longer term research. The success of the collaboratory also hinges on developing a virtual infrastructure that enables sharing and leveraging assets across universities and also building faculty collaborations that transcend the boundaries of departments and universities.

NWCSM'S ABILITY TO MEET THE NEEDS OF STAKEHOLDERS

Taken together, the research program for this project was designed to get insights into the issues facing the potential industry, government and educational stakeholders and participants in the NWCSM and then compare those to the lessons learned from successful benchmarked programs. The previous sections of this report laid out the overall perspectives of each stakeholder group. This section focuses specifically on the summary input from each stakeholder group on their interest in the proposed Collaboratory, the benefits they believe can accrue from this type of organization, and the likelihood that they would indeed participate. The overall implications of this for the viability, structure, and operations of NWCSM are addressed in the next and final section of the report.

Results From In-Person and Telephone Interviews

As noted earlier, there were two different stories that emerged from the in-person and telephone interviews with selected members of the metals manufacturing cluster. Group A and Group B companies are currently engaged with the educational entities in the region on different issues and have varied priorities moving forward. They do, however, share an interest in the proposed NWCSM as well as have similar concerns about how it will be structured and operationalized. This section outlines the areas of common purpose as well as some differences between the two groups of companies. Appendix F contains the detailed online responses from these two groups of companies regarding their priorities and wishes for the NWCSM.

Group A: The fabricated metal products manufacturing sector expresses pragmatic and practical need to enable their operations to become more efficient and more profitable. They receive support from associations and vendors and although they desire contact with higher education, they question if those relationships will have a positive impact their day-to-day operations.

Human resources is their first area of interest and this may be skewed by the fact that some of the company representatives are from the human resources function. These human resource needs focus on a few areas – metal fabrication and welding skills, access to continuing education, employee training and skill development, internship relationships and new hiring. The majority of these needs are not envisioned as a primary focus of the proposed NWCSM, particularly since there are already a number of separate initiatives around the state focused on workforce preparation and development at the community college and high school level.

Other business needs for this group include sustainability issues relating to cost control and waste management and, to a lesser degree, business planning.

Most of these companies are cautiously interested in the concept behind the NWCSM. They do not want to pay for this entity until it demonstrates value and some are suspect that the entity will be too bureaucratic. Those that support the NWCSM believe it should not be limited to the metals industry and several suggest that their customers would benefit from what the NWCSM

may offer. In fact, among both groups of companies, 60% of the seven firms that answered the online survey as well indicated that they thought the single most important benefit of the NWCSM was to "build economic development in the industry across the region". The second most important benefits of the collaboratory were to "provide research resources to help your company's R&D initiatives" and to "attract and retain skilled and trained employees to the industry".

Additional common considerations voiced about NWCSM include:

- Most express concerned that the universities are “too theoretical” and will not be interested in the day-to-day and more pragmatic needs of their businesses.
- Most suggest this organization should begin as a virtual entity with a close watch to keep it efficient, effective and economical.
- This group is familiar with entities that had some similar characteristics to the proposed NWCSM. Some of the most common examples of centers/consortia/collaboratories were MECOP, ONAMI, and the North American Die Cast Association.
- The final decision to participate in the NWCSM would be based not only cost and pragmatism of the organization's efforts, but also its overall value to the company. The most important benefit for Group A as noted in the more limited online responses was the "ability to develop tailored education for your employees", which was noted by 40% of the companies.

Group B: The large scale manufacturing group expresses a very different set of needs. Represented by only one company, their needs focus on the application of cutting edge technology in all aspects of their operations including applied R&D, engineering, operations and technology. This company ranked the ability of the NWCSM to support its product and technology needs as the most important benefit of the proposed group, and a major determinant of its decision to participate. To a lesser extent, business needs are also sought in the areas of sustainability and business planning.

Like its Group A counterparts, Group B desires improvement in the relationship and performance of the universities with the hope that these institutions can be more responsive to their specific needs in the future. This is a contrast to their closer association with universities in Western Europe. They have high regard for OMI and are optimistic about what NWCSM can offer. They too envision NWCSM as virtual organization sponsored by government funding and international resources as well.

Exhibit 29 on the next page summarizes the most commonly mentioned areas of need by these two groups.

Exhibit 29: Summary of Needs and Fit with NWCSM from Personal Company Interviews

	Group A	Group B
Human Resources		
Training		
Metal Fabrication/Shop Floor Skills	X	
Journeyman Certifications	X	
Internships		
Metal Fabrication Vocational/Welding	X	
Technical/R&D/Engineering		X
Hiring Resources		
Metal Fabrication Vocational/Welding	X	
Technical/R&D/Engineering		X
LEAN Manufacturing		X
Supply Chain Management		X
Sustainability		
Cost and Waste Control	X	
Comprehensive Assessment		X

Online Survey Responses

An earlier section of this report outlined the responses from those companies who participated in the online survey highlighting the most important business issues facing the companies, their current level of engagement with the university systems in Oregon and SW Washington, and their predictions about business revenue growth and capacity expansion over the next three years. The online survey demonstrates that these metals manufacturing companies are reasonably optimistic about their near term future, work hard to maintain and manage a regional eco-system of customers and suppliers, and are simultaneously focused on building the top-line revenue of the business through customer management as well as improving operational efficiency and employee productivity. Companies believe that they need to better manage the fluctuations in raw material costs as well as begin to develop more value added or differentiated products to improve overall profitability. However, the majority of companies do not believe that pushing to develop capabilities or skills in new materials or engineering technologies is essential to their business success in the near term.

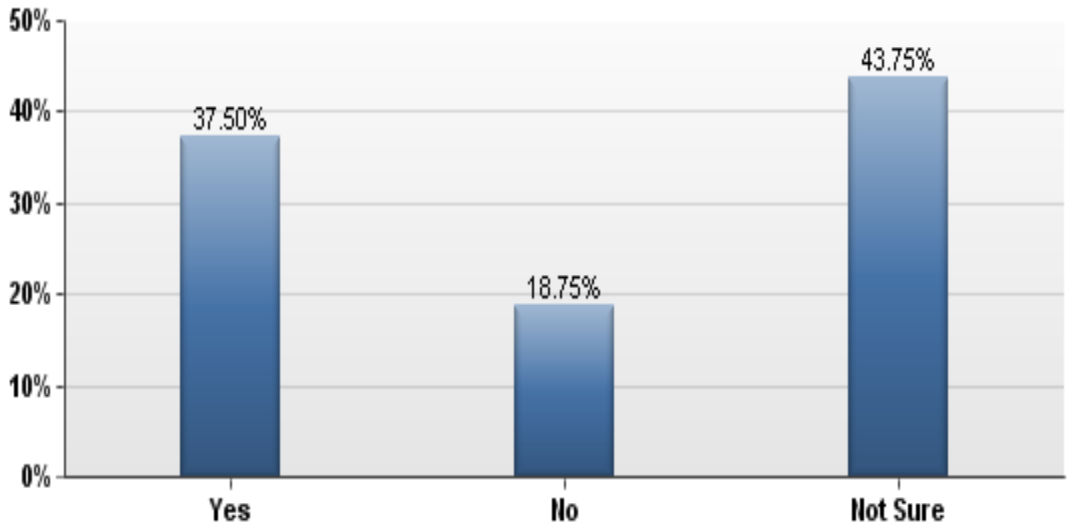
To support their efforts, the companies may have some external linkages into associations and industry organizations to provide some assistance and information about macro trends or issues facing the industry. The companies do not, however, have a strong connection to the local university or community college network and, in fact, do not think that this is a critical benefit to them of being located in this region.

Against this background, the online survey asked companies about what benefits they saw from

a collaborator such as NWCSM, their potential interest in the proposed NWCSM overall, what specific issues would be of interest to them to be included in the Collaboratory, and what factors would help influence their own company's decision to participate. The results of these questions are summarized below. Detailed responses are also contained in Appendix E.

On a macro level, the online survey respondents are not sure that the proposed NWCSM would support their own technological or business needs with 38% of the firms reporting stating "yes", 19% saying 'no', and the remaining 43% were unsure. Exhibit 30 illustrates this comparison.

Exhibit 30: Overall Appeal of NWCSM to Meet Technological or Business Needs (Q18)



The companies did indicate that they would be interested to see additional information about the proposed collaboratory and, in particular, would need to know more about its value proposition to their own business. Four (4) of the fourteen (14) comments provided specifically asked for technical training and skills development work, not surprising given the importance of human capital development the companies had noted earlier in the survey. Some of the comments about requiring additional information about costs also were expected.

The remaining comments indicated that what was most important was understanding what value this new group could provide in terms of specific services and insights to companies of their size or relative to offerings from other groups already in the market:

- "Practical, tangible involvement"
- "Concrete ideas and plans"

- "Service offered and their priorities"
- "How many competing organizations are doing the same thing? Even they are just doing tangential things, how many organizations do I need to be a part of to manage?"

The benefit of the proposed NWCSM in the eyes of the online industry respondents fits squarely in the area of developing and maintaining a healthy industry. None of the other six factors offered as potential benefits of the NWCSM combined for more than 30% of the #1 and #2 benefits. In fact, the most highly rated factors were the following:

- "Attract and retain skilled and trained employees in the industry" – Rated #1 or #2 top benefit by more than 60% of companies.
- "Build economic development in the industry across the region" – Rated #1 or #2 top benefit by more than 51% of companies.
- "Build connections between companies in the industry that can be developed into sales and marketing opportunities" – Rated #1 or #2 top benefits by more than 36% of companies.

Slightly more than one quarter of the companies who responded did see that having access to research resources that would help their own company's R&D would be valuable: more than 27% of companies indicated that this would be one of the Top #1 or #2 benefits of NWCSM. But beyond that, industry does not place a high value on NWCSM's ability to deliver value to the educational stakeholders:

- "Enable universities to seek grants that build capacity to support current and emerging technological needs of your industry" – Ranked by 15% of industry companies as either #8 or #9 (out of 9) in terms of benefits and by 45% as #7-#9.
- "Enable universities to seek grants that build capacity to support current and emerging business problem-solving and benchmarking needs of your industry" – Ranked as #8 or #9 (out of 9) by more than 45% of respondents and 66% as #7-#9.
- "Facilitate collaboration between faculty across OUS schools and WSU-V" – Had the lowest overall value, being ranked as #8 or #9 (out of 9) by almost 82% of industry respondents and 91% as #7-#9.

While on the face of it there appears to be a potentially serious mismatch in terms of expectations between the educational stakeholders and their industry counterparts, the online survey did indicate that companies, under the right conditions, might find the inclusion of universities in Oregon and SW Washington into the proposed NWCSM a value added idea. At a more granular level, the companies indicated that they would be most likely to use a regional linkage to a university or a community college for just a few key areas of support.

- About 52% of companies would be 'very likely' or 'likely' to contact a university or community college for career services related to technical hires.
- More than 46% of companies would be 'very likely' or 'likely' to contact staff training
- More than 43% of companies would be 'very likely' or 'likely' to contact for mechanical

engineering assistance or market research on customers and market segments
- About one-third, or 33% of companies would be 'very likely' or 'likely' to contact for career services support for professional hires
- Around the same percentage of respondents, 33%, would be 'very likely' or 'likely' to contact for lean manufacturing process assistance.

What is also notable in this area is the topics around which the companies are least likely to contact their local university or community college. The top two areas where companies are least likely to contact these resources are product development and product design, with more than 50% and 42% of companies saying they were either 'very unlikely' or 'unlikely' to contact respectively. This is notable since one of the existing programs in the metals manufacturing industry, the Oregon Metals Initiative, has done similar projects in the past and at least one of the OUS schools, the University of Oregon, has a full-fledged degree program in this area.

The third area where companies indicated that they were least likely to contact a university or community college was in the area of waste reduction and closed loop process design, with more than 35% of companies indicating they would be 'unlikely' or 'very unlikely' to reach out. This is particularly interesting since several of the OUS schools, notably PSU and UO, have strong programs in sustainable business practices where graduate students regularly do company projects in exactly these topics.

Finally, while 33% of companies indicated that they might look to universities for support in the area of lean manufacturing, another 35% said that they would be 'unlikely' or 'very unlikely' to do so. We believe that this is largely because of the strong and capable network of organizations like NWHPEC, Mid-Willamette, Emerald Valley Southern Oregon, or High Desert Performance Consortiums, already out in the region doing this kind of work through established company networks to offer organizational support.

Beyond the subject matter and focal areas for the Collaboratory, another objective of the survey was to identify what kinds of services or features would NWCSM need to include to be attractive to companies in the metals manufacturing sector.

Companies were asked to compare and rate the importance of different "member" categories, fee structures, activities, methods of accessing information, and types of project participation or access to knowledge.

- **Member Categories:** Respondents indicated that the value proposition for NWCSM needed a broad range of members included. In fact, nearly 76% of companies said it was essential to have members that included suppliers and competitors, while 60% felt that industry associations and professional networks should be included in any proposed membership.

- **Fee Structures:** The group as a whole did not really indicate that membership payment schedules would be a barrier to participating, even though the open ended comments above said that more information on costs would be essential to determine if a company would participate. 18% of respondents favored a single fee structure while

27% of companies favored a tiered payment model.

- **Methods of Accessing Information:** Overwhelmingly companies believe that NWCSM needs to operate in a virtual environment. In fact, companies want to access information via an easy to use website (82% rating as 'extremely important' or 'very important'). Beyond that, however, companies reacted favorably to the idea of NWCSM acting as a "concierge" and providing a single point of contact into the university system or industry resources that would help them match needs to resources (63% rating as 'extremely' or 'very important'). A members-only web portal similar to that on many of the benchmarked institutions also resonated with potential members, but at a much lower level (36% rating as 'extremely' or 'very important').

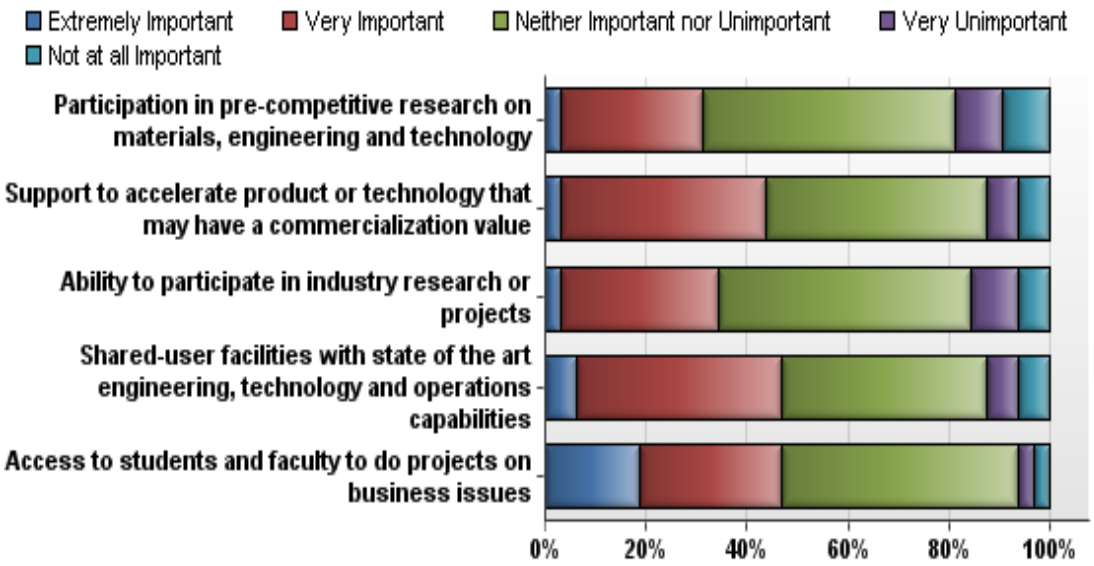
- **Knowledge Access and Involvement**: One of the foundational principles behind the proposed NWCSM is to provide metals manufacturing companies in Oregon and SW Washington access to research, technologies, faculty, students or shared use facilities that can help support the business. The online survey asked companies to rate the importance of five specific kinds of knowledge access and project participation, with each of these based on some of the core activities that had been seen in a number of benchmarked programs. The results of the survey for each of these five are shown in Exhibit 31 and summarized below.
    - 46% of companies indicated that having access to students and faculty to do projects on business issues would be either 'extremely' or 'very important' to their assessment of NWCSM. Again, it should be noted that there are already project resources available within many of the schools within Oregon and SW Washington, but these same companies have not used them to date. We interpret this contradiction, however, by assuming that having the one stop concierge model discussed above would reduce barriers to access and allow companies who are so inclined to find and match project resources to their needs.

    - A similar percentage said that having access to shared-user facilities with state of the art engineering, technology and operations capabilities would be either 'extremely' or 'very important' to their assessment of the value proposition of NWCSM. In our research we did not discover many instances where companies within the metals manufacturing industry had already availed themselves of shared use facilities similar to those run by Oregon BEST, ONAMI or CAMCOR so these firms may not even know that some of these types of facilities are open to them today.

    - 43% of companies indicated that they would be either 'extremely' or 'very interested' in accessing resources that would help them accelerate products or technology that might have a future commercialization value, but significantly fewer (31%) indicated an interest or need to participate in industry pre-

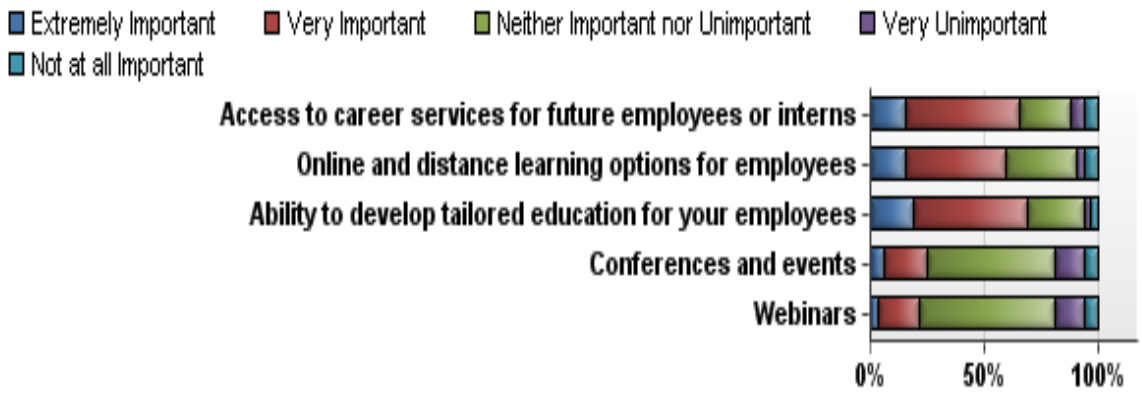
competitive research on materials, engineering and technology or even on industry shared research projects (34%). We have interpreted these results to be a further endorsement of the kinds of applied engineering projects currently undertaken by Oregon Metals Initiative on a company-specific basis, but not a widespread endorsement of the kinds of cooperative industry basic research seen in many of the benchmarked institutions.

Exhibit 31: Importance of Different Knowledge Access and Project Types in the Proposed NWCSM (Q17)



- **Services:** As shown in Exhibit 32 on the next page, the most important services for the respondents from NWCSM continue to revolve around access to career services or educational options for current employees. More than 68% and 59% of respondents indicated that developing tailored education options or providing online/distance education options for employees would be 'extremely important' or 'very important' to their decision to participate in NWCSM. Having access to career services for employees or interns would be 'extremely' or 'very important' to 66% of respondents, a result we found surprising since these resources are already available, but as discussed earlier, companies have not yet engaged with the university system to access them.

Exhibit 32: Importance of Membership Services in Proposed NWCSM (Q17)



Results from Faculty and Deans

There appears to be a notable interest within the OUS and WSU-V at both the faculty and dean levels to support the concept of NWCSM. Each specific group within the educational stakeholders may have a slightly different set of motivations, but some general shared principles are as follows:

- Cross-university collaboration among the OUS entities would benefit each school individually, the statewide system, and the industry overall.
- Opportunities for industry work do offer the chance for additional leverage by faculty towards NSF or other government grants. Although, many faculty do not perceive this to be a necessary or winning criteria.
- Academic (i.e., tenure track) faculty members will participate to the extent that the research questions posed by industry "fit" their own research interests and can be addressed within available timing.
- Non tenure track faculty and faculty who do not have as high a pressure for publishing rigorous academic research are more likely to engage in industry funded projects.
- Currently, there appears to be at most one faculty at each school that strongly meets the criteria for an ideal candidate for the industry when one considers expertise, interest, and capacity for metals research. OSU is currently hiring a tenure-track faculty focused on metals research. A senior faculty member at PSU who is actively focused on metals research for the industry is close to retirement.
- Applied and non-tenure track faculty are equally attracted by the opportunity to leverage experiences into the classroom through training or capstone projects as well as the opportunity to work with students to publish results.
- Students will benefit from industry involvement by having their overall coursework incorporate more of today's pressing engineering, technology and business issues.
- Oregon Metals Initiative is by far the largest conduit of sustained funding for metals related research that brings the industry in the region and faculty together. A few

faculty at OSU and PSU that have significant interest in more applied research are undertaking the bulk of this research.

- There are significant pools of experience in applied engineering, and particularly in metals, composites and ceramics, at OIT that have not yet been incorporated into the Oregon Metals Initiative. Similarly, there are faculty resources at WSU-Vancouver in the area of metals and composites that could be leveraged through the Oregon Metals Initiative to benefit the industry. All of these resources should be actively incorporated into the proposed NWCSM
- It is also important to see the progression of interaction and collaboration across OUS and WSU-V schools with MFG 21 and PDC in recent years that have provided a strong impetus for the evolution of the concept of the collaboratory.
    - PSU, UO, OIT, and WSU-V have engaged with MFG 21 as a team for seeking federal funding in 2009 and 2010, with significant success. The same team also successfully engaged with PDC, MFG 21, and other stakeholders to seek the JIAC1 Grant in 2011. OSU and PSU have also engaged extensively with OMI over the years.
    - In 2011, OSU, PSU, OIT, UO, and WSU-V in collaboration with MFG 21 prepared a white paper to further shape the vision and mission for NWCSM to seek funding from the state legislature in Oregon and appeal to OUS to make it a strategic priority to establish NWCSM. All the schools have engaged together successfully with CREDC in seeking JIAC2 Grant in 2012.
    - While the interaction across OUS and WSU-V schools has increased considerably in 2011 and 2012, this initiative has not yet gained the serious attention of Deans and Provosts across OUS and WSU-V, for them to deem it a strategic priority to collectively champion for the collaboratory.
- Nevertheless, the process of stakeholder engagement in this NWCSM study has been an avenue that has further raised the awareness of this initiative across a larger base of faculty and senior leadership across OUS and WSU-V.

Overall Conclusions

- There is a need to further mobilize the interaction between faculty who are currently not engaged in NWCSM or Oregon Metals Initiative and the partners in the metals industry to further match the faculty expertise and capacity across OUS and WSU-V with the needs of the industry.
- Tenure-track faculty interest is not enough to generate a sustained capacity for supporting relatively more applied and short-term needs of the industry.
- There is a serious need to first grow the base of non-tenure track research faculty or faculty with significant interest in metals related applied research.
- A serious engagement by both tenure-track and non-tenure track research faculty is needed to build the research capacity for near, medium, and long-term research needs

of the metals-based firms.

- NWCSM needs to find a way where the industry is not only looking for more short term needs, but is willing to engage with universities to engage in medium and longer-term technological needs. The long term success of NWCSM will rest on the ability to tap into the expertise and capacity of non-tenure track research faculty, applied research faculty, and tenure track (pursing academic and longer term research) faculty.

Immediate Next Steps to Further Validate Scale and Scope for NWCSM

- Organize a major NWCSM kickoff retreat to engage a) key faculty across OUS and WSU-V with significant interest in academic and applied research related to the needs of the metals firms; b) department chairs; c) deans; d) members of the industry; e) other key stakeholders (e.g. PDC and other economic development agencies) to understand assets, expertise, and capacity across OUS and WSU-V vis-à-vis the demand for business and technological needs of metals manufacturing firms.
- Explicate the nature, scale, and scope of the technological needs of the metals-based manufacturing sector in the region.
- Identify key assets, expertise, and capacity required in OUS and WSU-V with reasonable specificity (to meet industry needs for applied research and technical services).
- Discussion at the retreat should be primarily moderated by an academic champion (engineering faculty/chair/dean/provost) and a couple of representative champions in the industry.
- The following questions must be addressed
  - What is the overarching need to go well beyond the current state of OMI?
  - What is the portfolio of the work that can be undertaken using the expertise and capacity of tenure track research faculty via senior projects, internships, masters theses, and doctoral dissertations?
  - What is the portfolio of work that can be undertaken by using the expertise and capacity of non-tenure track research faculty via senior projects, internships, and masters theses?
  - What type of equipment, lab, & other infrastructure is needed to support the needs of the industry?
  - How to facilitate the expansion of OMI in a manner that results in a synergistic, flexible, autonomous, scalable, and seamless interaction with NWCSM?
- At the end of the retreat, it should become abundantly clear to all parties as to the specific nature of OUS and WSU-V assets that are needed to support the technological needs of the metals-based manufacturing sector. It must result in a compelling imperative for NWCSM to justify taking the next steps as outlined by the blueprint for guiding a phased implementation (appears in the ensuing section).

- Subsequently, a core team comprising members from engineering schools and pivotal partner firms should perform a thorough gap analysis for the right type of both faculty capacity and infrastructure (labs and equipment) vis-à-vis the nature, scale, and scope of the technological support envisioned for the industry over next five years.
- Sub-groups can be formed with representatives from key stakeholders across NWCSM to further explore the specifics of the nature of pull from the industry and push (supply) of faculty expertise/capacity. It will also be important to have representatives of the economic development entities to be present during these discussions to gain a first-hand view of the needs of the metals-based eco-system .
- Business schools across NWCSM should find it relatively easy to engage with metals manufacturing firms in applied research, benchmarking, experiential education initiatives (i.e., problem solving projects with students), and continuing/executive education to offer the requisite capacity to enhance sustainability and competitiveness of metals manufacturing firms in the region.
- Once the value proposition being offered by NWCSM is clear and compelling to all key stakeholders, the discussion can shift to governance and budgetary issues.

IMPLEMENTATION REQUIREMENTS FOR A SUCCESSFUL NWCSM

Viability of the Proposed NWCSM

The many faceted research effort undertaken since Summer 2012 has resulted in a number of key findings, all of which affirm our cautious optimism about moving ahead with the proposed NWCSM. This conclusion is based on the following foundation:

- There are proven business models for a collaboratory similar to that envisioned by NWCSM.
- The intersection of faculty interest and industry interest is significant to conclude that there may be enough to go on and start the next discussion of implementation and initiation for NWCSM. In essence, there appears to be a "coalition of the willing" from both industry and the educational entities in Oregon and SW Washington who want to work to bring this vision into a reality.
- Even though the largest firms in the cluster in the state can, and do get technical and research help nationally or internationally, these firms are able to see that their participation is essential to build the capacity with the smaller and medium-sized supply base and customer base in the cluster.

Yet our conclusion is tempered by caution in the following areas:

- If the largest investment is required to come from the OUS or the State, which are subject to prioritization and changes as the state's overall economic conditions change, without substantive and long term commitments from industry, then the longer term viability of NWCSM is at risk. There may just be a smaller handful of businesses that will commit to financial support for required investments over a three + year period. Stating interest in working on the consortia is not the same as having a number of companies who are willing to provide substantive and long term commitments to help financially underwrite the start-up effort.
- Some academic research faculty will be very selective in their levels of engagement. At the same time, NWCSM can start operating successfully if there are enough applied faculty who are engaged. Not having enough NTTF who can directly engage in applied engineering research and activities will raise the risk of not delivering on the value proposition, thus not meeting industry expectations.
- On educational side, there are few programmatic examples of inter-entity cooperation; where it exists now with the academic faculty, it is based on individual faculty connections. There are models via Oregon BEST that have demonstrated this kind of OUS wide cooperation, but they are at a very different scale than that which should be expected from NWCSM.
- Most companies today are looking at "little 'r' and big 'D'" or incremental innovations. Limiting to today's current metal-based needs prevents the opportunity for larger investments in the newest cutting edge innovations that might bolster the scale of the Collaboratory, both on the industry side and educational infrastructure. In fact, adapting or addressing longer term potential substitutions of metals by advanced

materials would likely require a larger conversation at OUS level as to whether new degree programs in things like material sciences are appropriate. Demand for some of the more specialized and cutting edge needs in metals manufacturing may lack enough scale to get significant attention within the university system.

- Similarly, if there is a lack on investment in community colleges and high schools for vocational and work force training, then some of the fundamental issues for the industry that will help secure its future success will not be addressed

Business Imperatives

Out of our conclusions come the following imperatives or "must get rights" for NWCSM as it moves to become a reality:

- Be focused and nimble to start
- Build off existing successes, particularly that of the Oregon Metals Initiative
- Have a phased evolutionary program
- Don't invest in brick and mortar, but in human capital and virtual infrastructure
- Have clear milestones of success
- Integrate industry and academics not just on governance, but on the projects, programs and operational side
- Build substantive longer term commitments for industry funding before proceeding
- Validate the evolutionary recommendations with those who will be participating
- Share equipment or lab investments among the educational stakeholders as well as industry participants

Building the NWCSM - Detailed Recommendations

Using the same topics that we discussed earlier for the benchmarking institutions, we recommend that NWSCM be built upon the following recommendations.

- **Scope of Industry Served:** NWSCM should continue with its planned focus on the metals manufacturing industry, but we recommend that this be broadened to include the larger supply chain or ecosystem of the metals industry, including suppliers and customers.
- **Breadth and Balance of Network:** Many of the top interests of the industry center around work force development and technical training. These are not going to be met by NWCSM, but the collaboratory needs to build some strong network relationships with organizations throughout the state that can provide these resources to the industry. Similarly, NWCSM should not have a core economic development or lean manufacturing focus to its programs; there are an ample number of groups throughout the region who specialize in these areas. To work effectively to serve its members,

NWCSM must however, know enough about the programs and efforts of these groups to act as a 'concierge' to its own members.

- **Scope of Services, Projects and Research:** The primary initial focus of NWCSM should be to expand university-industry linkages in the areas of applied engineering, technology and operations. Over time the stream of project work on sustainability, commercial, and business issues will grow, but in the near term these should be addressed on an ad hoc basis as they arise. Projects will continue to be undertaken on a proprietary company-specific basis, but initial work will be done to stimulate shared projects that will benefit the industry overall. Projects must be managed from the start so that they balance the expectations of academics and industry.
- **Industry Engagement:** NWSCM must explicitly work to include small, medium-sized and large firms in the region. Engagement does not just mean offering memberships; it means putting in place a governance and project selection process that ensures that all members have a voice about organizational priorities.
- **Faculty, Students and Workforce:** The selection and matching of projects to faculty interests must be done with an appreciation of the need to balance competitive imperatives for the firm with the academic interests in publishing and disseminating knowledge. NWCSM can play a forceful role in attracting graduate and post-doctoral students to the region, and thus growing overall capacity at the educational institutions, by offering these students the opportunity to work collaboratively on issues which are essential to the industry. Some of these same students are likely to then stay and become part of the workforce for the industry into the future.
- **Structure:** NWCSM must be structured as a connector between the universities and industry. Its staff must remain lean and flexible, delivering services throughout the region in as virtual a model as possible, thus managing to reduce overhead.
- **Financial Commitments and Revenue Model:** NWCSM needs a substantive multi-year commitment from both the state, governmental organizations, and founding/leading corporate members of the industry to become a reality.
- **Governance:** The NWCSM governance structure must include members of each core stakeholder group. Membership among industry players should be enhanced by developing a set of working groups and committees that will help engage members, develop future leaders, and enhance the membership development process throughout the industry.

An Evolutionary Model

NWCSM should be started with a two phase growth model that will cover the next five years of operations. The details of each of the growth phases are outlined below,

STAGE 1 – YEARS 1 and 2

- **Scope of Services:** Primary focus is to advance engineering needs of the industry. Infrastructure is being set up to facilitate coordination and matching of needs to capacity with the educational institutions that have deep engineering, technology and operations capabilities. Projects will largely be done on a proprietary company-specific basis for Year 1, but the project selection and funding mechanism will be set up to support shared projects as they arise. From inception the Collaboratory will be available to simultaneously support industry needs for high value projects that address larger business challenges in strategy, operations, supply chain, and sustainability, however the number and scale of these projects are expected to be smaller and will be matched on as needed basis.
- **Oregon Metals Initiative:** Keep administrative, project selection, and funding structure as is. At the same time strengthen in terms of participants (OIT and WSU-Vancouver) so as to provide more project capacity. This can be done with little to no additional cost or administrative burden.

  Simultaneously enlarge the funding base so as to fund more projects of four participating entities (OSU, PSU, WSU-V, OIT) as well as initiate the building of a seed fund so OMI projects are accessible to smaller or fastest growing firms . Seed fund could be funded by OUS, state or by industry partners who want to sponsor work with a supplier or customer. Efforts should be made to double the size of the OMI budget from approximately $900,000 per biennium to $2 million per biennium and to establish an additional $ 1 million seed fund that would provide an additional $500,000 per year to the OMI (in Stage 1).

  Expanding OMI offers the following benefits:

  - To industry: Additional access to applied research which they say they want, leverages industry funding through the matching , strengthens value chain/supply base in the region and maybe even job growth, but at least enhances competitiveness of existing firms
  - To educational stakeholders: Funds additional graduate students, provides experiential opportunities, introduces industry realities into the classroom, highlights or illuminates manufacturing as a career opportunity to the state's university graduates
- **New OUS Capacity:** Supporting the expansion of OMI necessitates more faculty who want to be engaged with NWCSM. The goal would be to have five (5) new faculty on board by the end of Year 1. The distribution of these faculty among these entities would be matter of discussion at Dean or Provost level.

The first preference is to find one tenure track faculty whose research is strongly aligned with metals industry. Next four hires would be Applied Faculty (e.g., NTTF researchers) who would ideally be experienced industry professionals or engineering PhDs who have chosen academia to work with industry, rather than do academic research.

These Applied Faculty could be hired with job descriptions that include up to five roles:

- Strongly interface with industry
- Run applied projects/research funded through OMI
- Collaborate with academic faculty
- Oversee graduate students
- Teach 1-2 classes a year in order to bring industry insights into the classroom.

The OUS should expect to fund these from OUS and/or state monies. For planning purposes we have assumed that it will be necessary to make these hires from out of the region. Total cost for this effort would be approximately $2.1-$2.2 million over 3 years as follows:

- $100K person +OPE at 35% = $135K per year per faculty member or $675,000 per year
- $25K in relocation costs per faculty for total of $125K onetime expense
- Provide a contract that offers a commitment for a minimum of 3 years
- $2.1 -$2.2 million over 3 years for staff costs
- Additional work would have to be looked at to see if investments are required for labs or other equipment with a mechanism for sharing

- **NWCSM Staff Priorities:** As a start-up the NWCSM organization would define tasks and hire staff to do the following:
  - Forming relationships between universities and industries
  - Industry outreach
  - Developing an inventory of faculty, experiential opportunities, resources within each school and then packaging that for the industry
  - Taking incoming calls, doing a needs analysis and forming a match
  - Building relationships with associations and other related groups who work in this space, e.g. workforce, economic development, specialized topics like lean manufacturing
  - Build and maintain a virtual communications hub for industry players to access this information
  - Build marketing materials that outline the NWCSM value proposition and cultivate companies so that they will be willing to pay a membership fee in Year 2 and beyond
  - Develop specialized or unique services that are not elsewhere , e.g. webinars or hot topics and then determine which can be replicated and be made standard

offerings for the industry participants
    - Solicit and gather industry and faculty folks who would be willing to serve on various committees – project selection, issues, etc.
    - Be the point of contact for what is happening in the industry
    - Report out to Board of Directors and manage milestones
    - Work jointly with associations and other groups to sponsor talks/webinars etc. so as to leverage investments

- **New NWCSM Capacity:** Hire one Director for Year 1 and grow staff to include administrative support in Year 2. Hiring a Director with substantive industry experience is critical and a minimum commitment of two years will be needed. Assess additional need for staff beyond Year 2. Total staff and organizational costs for first two years is estimated at $665-$670K as follows:
    - Director salary estimated at $120K per year plus benefits estimated at the OUS level of 35%, or $162K per year
    - Relocation budgeted at $25,000 in onetime costs
    - Administrative support estimated at $50K plus benefits at 35% or $67,500 per year
    - Staff costs total $187K in Year 1, $230K in Year 2. Total staff costs over first phase is $417-$420K.
    - Plus approximately $100,000 annually in budgets for contract services like web development, webinar/video technical support, travel. Office space cost could be minimized by co-locating with another entity.
- **Governance:** Establish the initial board of directors and fill seats with industry, education and public entity members. Supplement this with industry issues committees which could be focused either on a sector cluster, issues, or supply side topics like education, research, membership. The target board size should be kept at no more than 14-16 as follows:
    - Universities have 5 seats that rotate between each school and an OUS representative
    - OMI should have one member
    - Founding members each get a seat and we have estimated that there may be 3-4 who will fit into this category to start
    - Smaller/medium sized firms should have 2 rotating seats with a representative selected from the membership of each tier
    - Public entities should have 3-4 seats representing the State of Oregon, MFG21, PDC, and perhaps a member from another cluster development entity like an Oregon BEST or one from an association/economic development group

- **Funding:** Getting NWCSM up and running will require a complex set of financing and investment commitments including:
    - OMI expansion will go through the existing OMI channels, funded by industry and matched by state funds
    - Starting up an OMI Seed Fund requires additional work to set up, but we would expect that to be funded by industry and the state overall, particularly given the potential impact this would have on the state's smaller and fastest growing members of the cluster
    - State and/or OUS should fund the new five faculty positions
    - Founding member membership model has to start at Year 1 before NWCSM is started. Operating funds and staff for NWCSM staff will be paid from these monies
    - Tier 2 and 3 membership model to start at Year 2. Amount to be determined.

- **Goals and Milestones:** As noted earlier, the most successful collaboratories set out their goals and then put in place performance measures to track successful accomplishment of these milestones. For the first phase of NWCSM at least some, if not all, of the following measures should be considered:
    - A total annual budget of **$2.5M -$3.0M** to fund operations of staff of NWCSM and expanded OMI projects
    - Staff of 2-3
    - 5 new faculty within OUS or WSU-V who are working on these issues more than 80% of the time
    - Increase in graduate students who are working on these projects and are therefore funded for their studies
    - Publications and presentations on project results
    - Public relations hits on NWCSM's activities
    - Membership agreements developed and put in place
    - Virtual presence and online experience usage
    - Member satisfaction
    - Operation of a full board of directors representing all stakeholders

STAGE 2 – YEAR 3, 4, and 5

- **Scope of Services:** Continue with active set of programs to advance applied engineering needs of the industry. Projects will continue to be done on a company-specific and proprietary basis, but evidence of both inter-educational entity collaboration and industry shared projects is emerging, spurred on by the NWCSM Board of Directors and member groups. NWCSM begins to build advanced manufacturing capabilities at large, extending beyond the metals cluster, up and down the supply chain to offer full service to the manufacturing base. The scale of projects focused on larger business challenges increases by incorporating strategy, operations, supply chain, and sustainability. There is now in place an active membership model spanning large to smaller firms complimented by discrete programs offered by NWCSM to support the members.

- **Oregon Metals Initiative:** OMI continues to run with a larger number of projects from Stage 1, but may begin to extend into new materials science/engineering areas to meet both the short and longer terms needs of the metals industry. OMI expansion in Stage 2 should support a budget of $2.5M per year.
- **New OUS/WSU-V Capacity:** Continue to build capacity and connections for regional educational entities with industry and academic counterparts who are working on advanced manufacturing issues within the metals manufacturing industry as well as within the larger supply chain of the industry.
- Determine need and demand for additional applied faculty based on progress and milestones met in Stage 1. If the number of applied projects has expanded beyond faculty capacity, then initiate process with OUS/WSU-V to hire additional faculty. Increased capacity across OUS/WSU-V with a prudent mix of tenure track and non-tenure track research faculty in metallurgy/MME. This faculty capacity expansion in Stage 2 should support a budget of $1.0M per year.
- Encourage schools to build academic research connections and collaborative relationships with international or national institutes that have complementary interests such as some of the collaboratories that were evaluated as part of this project.
- Integrate Expertise/Capacity at B-Schools across NWCSM to support Metals Manufacturing Firms. This holistic expansion to meet both business and technological needs of the metals industry should support a budget of $350K per year for the Business-Schools in NWCSM.
- At the Dean or Provost levels, begin to develop commitment for material sciences expertise across a wider gamut of technologies that will be highly interlinked and distributed across campuses.
- **Staff Function:** Same as Stage 1, but extend to offer a larger set of membership benefits, including more standard replicated services.
- **New NWCSM Capacity:** Retain Stage 1 Director and Administrative Assistant, but add Membership Director and Program Director. Total organizational and staff costs increase to $650K per year.

- Membership Director estimated at $60K plus benefits at 35% or $81,000 per year
- Program Director estimated at 60K plus benefits at 35% or $94,500 per year
- Increase annual budget to approximately $150,000 to provide for events and educational services as well as maintain contract services like web development, webinar/video technical support, travel .
- Consider potential need for larger dedicated office space or whether co-location with a staff of four (4) is still possible.

- **Governance:** Retain Stage 1 structure. Actively incorporate membership from smaller and medium sized firms or all levels of membership fees.
- **Funding:** Retain same mix as Stage 1, but at this point membership fees should be expanding as a percentage of total revenue. Program fees will emerge as a source of revenue as well.
- **Goals and Milestones:** For the second phase of NWCSM at least some, if not all, of the following measures should be considered:
  - A total **annual budget of $4.5M - $5.0M** to fund operations of staff of NWCSM and expanded OMI projects (this does not include any investments in labs or equipment)
  - Staff of 4+
  - Increase in members by tier
  - Membership retention rates
  - Number of completed projects
  - Number of programs and events run
  - Attendance and participation by event
  - Increase in graduate students who are working on these projects and are therefore funded for their studies
  - Publications and presentations on project results
  - Public relations hits on NWCSM's activities

APPENDICES

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APPENDIX A: DETAILED NAICS CODES

331 - Primary Metal Manufacturing

3311 - Iron and Steel Mills and Ferroalloy Manufacturing
3312 - Steel Product Manufacturing from Purchased Steel
3313 - Alumina and Aluminum Production and Processing
3314 - Nonferrous Metal (Except Aluminum) Production and Processing
3315 – Foundries

332 - Fabricated Metal Product Manufacturing

3321 - Forging and Stamping
3322 - Cutlery and Handtool Manufacturing
3323 - Architectural and Structural Metals Manufacturing
3324 - Boiler, Tank, and Shipping Container Manufacturing
3325 - Hardware Manufacturing
3326 - Spring and Wire Product Manufacturing
3327 - Machine Shops; Turned Product; And Screw, Nut, and Bolt Manufacturing
3328 - Coating, Engraving, Heat Treating, and Allied Activities
3329 - Other Fabricated Metal Product Manufacturing

333 - Machinery Manufacturing

3331 - Agriculture, Construction, and Mining Machinery Manufacturing
3332 - Industrial Machinery Manufacturing
3333 - Commercial and Service Industry Machinery Manufacturing
3334 - Ventilation, Heating, Air-Conditioning, and Commercial Refrigeration Equipment Manufacturing
3335 - Metalworking Machinery Manufacturing
3336 - Engine, Turbine, and Power Transmission Equipment Manufacturing
3339 - Other General Purpose Machinery Manufacturing

336 - Transportation Equipment Manufacturing

3361 - Motor Vehicle Manufacturing
3362 - Motor Vehicle Body and Trailer Manufacturing
3363 - Motor Vehicle Parts Manufacturing
3364 - Aerospace Product and Parts Manufacturing
3365 - Railroad Rolling Stock Manufacturing
3366 - Ship and Boat Building
3369 - Other Transportation Equipment Manufacturing

APPENDIX B: DATABASE DEVELOPMENT AND ONLINE SURVEY PROCESS

1. Access Reference USA database through the University of Oregon library system and conduct custom searches using the specified NAICS codes and geographic filters (Oregon - all counties, Washington - Clark County)
2. Review for companies that were misidentified by NAICS and eliminate, e.g. telecom providers, jewelry stores, stationery and paper suppliers.
3. Review for duplicate names. If company, address, phone and executive information was identical, then eliminate. If company and executive information was identical, but two different addresses and phone numbers were provided, the record was retained, as this most likely represented a branch or satellite office, particularly if the sites were in two different counties.
4. Highlight companies identified by MFG21 and PDC as interview targets.
5. Determine email addresses to send the online survey
    a. For companies that had a web address already provided in the database, access site and determine email address for management or executives by searching through site, particularly looking for addresses in the "About Me", "Management" or "Contact" sections.
    b. For companies that did not have a web address provided, do a general search through Google to determine if there is a company web address. If so, add that to the database record. Then complete same search as 3a.
    c. If no email address can be found for executive listed on database, determine if there is a general email for "Sales" or "Info". Update database with those email addresses, keeping them separate from management emails.
6. Group email addresses into three categories – management, sales and general information
7. Send email introducing project and survey to targeted companies.
8. Tabulate and analyze results of online submissions.

APPENDIX C: IN-PERSON OR TELEPHONE INDUSTRY INTERVIEWS CONDUCTED

• Stuart VanReitt	Human Resources Manager	Small Parts Manufacturing Co. Inc.
• Alan Melton	President	Amfor Electronics
• Ron Davis	CEO	Davis Tool Inc.
• Sean Smith	Vice President	TVT Die Casting
• Josh Sutter	Vice President	HW Metals
• Dave Randall	Human Resources Manager	Columbia Steel Casting
• Nels Plough	President	Stack Metallurgical
• Gary Rehnberg	President	Eastside Plating
• Jim Olson	President	Beall Trailers of Oregon
• Ed Smith	Shop Manager	Premier Gear & Machine
• Mark Beasley	Vice President	Benson Industries
• Jeff Brown	President	Transco Industries
• Don Hendrickson	Senior Finance Manager	Boeing

APPENDIX D: ON-LINE SURVEY

Q1 This questionnaire is intended to gauge/understand the metals manufacturing industry's current or potential interest in The Northwest Collaboratory for Sustainable Manufacturing (NWCSM) This survey is part of a study sponsored by the Manufacturing 21 Coalition and Portland Development Commission. Faculty and students from University of Oregon's Lundquist College of Business are conducting the research on behalf of the sponsors. The purpose of our research is to evaluate the desire by manufacturing companies for stronger, more accessible and coordinated applied research and education programs in our universities. The goal is to build capacity to support industry outreach, enable universities to conduct research and leverage funding, and enhance teaching, all of which will advance the competitiveness of the manufacturing base in the region, and metals manufacturing industries in particular. The information you share with us will shape a business plan for the Northwest Collaboratory for Sustainable Manufacturing (NWSCM) a partnership between the Manufacturing 21 Coalition, Washington State University Vancouver, Portland State University, Oregon Institute of Technology, University of Oregon and Oregon State University. All the raw data being collected is confidential and will be aggregated to highlight the perspectives of industry. The survey should take no more than 10 minutes to complete.

Q2 Which business segment best describes your company's primary business focus?

- ❍ Manufacturing (1)
- ❍ Engineering (2)
- ❍ Service and/or Repair (3)
- ❍ Recycling and/or Disposal (4)
- ❍ Other (5)

Answer If which business segment best describes your company's prim... Manufacturing Is Selected

Q3 Which of the following sectors of the metals manufacturing industry best describes your business?

- ❍ Primary Metal Processing and Manufacturing (Iron, Steel, Alumina), including Foundries (1)
- ❍ Fabricated Metal Product Manufacturing (Forging, Stamping, Cutlery, Hardware, Boilers and Tanks, Springs, Wire, Coating, Engraving), Including Machine Shops (2)
- ❍ Machinery Manufacturing (Agriculture, Construction, HVAC, Engine, Industrial, Metalworking Machinery) (3)
- ❍ Transportation Equipment Manufacturing (Vehicles, Aerospace, Railroad, Ship, Boat) (4)

Q4 Approximately what percent of your key suppliers are located in the following areas?

_____ Mainly based in Oregon/SW Washington (1)
_____ Primarily based in the greater Pacific Northwest (2)
_____ Distributed throughout the rest of the USA (3)
_____ Distributed globally (4)

Q5 Approximately what percent of your firm's customers are located in these areas?

_____ Mainly based in Oregon/SW Washington (1)
_____ Primarily based in the greater Pacific Northwest (2)
_____ Distributed throughout the rest of the USA (3)
_____ Distributed globally (4)

Q6 How important are each of the issues facing your own company's competitive success over the next three years?

	Extremely Important (1)	Very Important (2)	Neither Important nor Unimportant (3)	Very Unimportant (4)	Not at all Important (5)
Build stronger brand name and awareness (1)	❍	❍	❍	❍	❍
Keep existing customers (2)	❍	❍	❍	❍	❍
Attract new or a more diverse set of customers (3)	❍	❍	❍	❍	❍
Enter new domestic markets (4)	❍	❍	❍	❍	❍
Establish a stronger international market position (5)	❍	❍	❍	❍	❍
Use new technologies to improve engineering capabilities (6)	❍	❍	❍	❍	❍
Strengthen material development and research (7)	❍	❍	❍	❍	❍

Develop new, differentiated or value added products (8)	❍	❍	❍	❍	❍
Manage raw material costs (9)	❍	❍	❍	❍	❍
Reduce risk of supply chain disruptions (10)	❍	❍	❍	❍	❍
Improve efficiency in operations (11)	❍	❍	❍	❍	❍
Restructure pricing (12)	❍	❍	❍	❍	❍
Improve logistics/distribution options (13)	❍	❍	❍	❍	❍
Improve inventory management (14)	❍	❍	❍	❍	❍
Build more manufacturing capacity (15)	❍	❍	❍	❍	❍
Increase training and skills of employees (16)	❍	❍	❍	❍	❍
Attract and retain employees (17)	❍	❍	❍	❍	❍
Improve employee productivity (18)	❍	❍	❍	❍	❍
Comply with environmental laws (19)	❍	❍	❍	❍	❍
Move to consolidate through mergers or acquisitions (20)	❍	❍	❍	❍	❍

Q7 Which best describes how you expect to manage the capacity (equipment, technology, employees) of your business during 2013?

- ❍ Add capacity (1)
- ❍ Maintain capacity (2)
- ❍ Reduce capacity (3)
- ❍ Don't Know (4)
- ❍

Q8 Which statement best describes your company's hiring and investment plans for 2013?

- ❍ We are aggressively investing in new technology and expanding our workforce (1)
- ❍ We are aggressively investing in new technology but not expanding our workforce (2)
- ❍ We are hiring, but not investing in new technology (3)
- ❍ We are neither hiring nor investing in new technology (4)

Q9 How did your company's revenue change over the last year and how do you expect it will change in 2013 and the next three years?

	Increase (1)	No Change (2)	Decrease (3)	Don't Know (4)
Last Year (1)	❍	❍	❍	❍
2013 (2)	❍	❍	❍	❍
2014 (3)	❍	❍	❍	❍
2015 (4)	❍	❍	❍	❍
2016 (5)	❍	❍	❍	❍

Q10 How important are the following benefits of maintaining a location in Oregon/SW Washington in keeping your organization competitive?

	Extremely Important (1)	Very Important (2)	Neither Important nor Unimportant (3)	Very Unimportant (4)	Not at all Important (5)
Hiring and retaining labor (1)	❍	❍	❍	❍	❍
Customer relationships (2)	❍	❍	❍	❍	❍
Supplier relationships (3)	❍	❍	❍	❍	❍

Access to technical assistance (4)	❍	❍	❍	❍	❍
Quality of community colleges (5)	❍	❍	❍	❍	❍
Quality of universities (6)	❍	❍	❍	❍	❍
Regional infrastructure (transportation, utilities, etc.) (7)	❍	❍	❍	❍	❍
Regional business taxes (8)	❍	❍	❍	❍	❍
Regional cost of living (9)	❍	❍	❍	❍	❍
Regional business costs (rent, labor, etc.) (10)	❍	❍	❍	❍	❍
Regional quality of life (11)	❍	❍	❍	❍	❍
Network of other firms in your business (12)	❍	❍	❍	❍	❍
Access to professional associations (13)	❍	❍	❍	❍	❍

Q11 Are you a member of any industry networks and professional associations?

- ❍ Yes (1)
- ❍ No (2)

Answer If Are you a member of any industry network... Yes Is Selected

Q12 What are the most important industry networks or professional associations for your firm?

Q13 What is your current level of your engagement with Universities (i.e., Engineering/ Science/Business Schools at OSU, PSU, OIT, UO, or WSU-Vancouver) for supporting any of the following needs?

	Significant & Ongoing Engagement (1)	Some Engagement (2)	Little Engagement (3)	No Engagement (4)
Core Research (e.g. materials, products, systems) (1)	❍	❍	❍	❍
Applied Technology(e.g. materials, product, process, systems development) (2)	❍	❍	❍	❍
Other Business Needs (e.g., benchmarking, market research, data mining, business planning, forecasting, process analysis/improvement, among others) (3)	❍	❍	❍	❍
Employee and Hiring Needs (4)	❍	❍	❍	❍

Q14 In the last year have you contacted your local university or community college to inquire about business assistance?

- ❍ Yes (1)
- ❍ No (2)

If No Is Selected, Then Skip To A collaboratory such as the NWSCM cou...

Q15 What prompted you to call?

Q16 Did you get the assistance you were looking for?

Q17 If a Collaboratory was set up in the region focused on metals manufacturing firms, how important would each of the following be in your company's decision to participate?

	Extremely Important (1)	Very Important (2)	Neither Important nor Unimportant (3)	Very Unimportant (4)	Not at all Important (5)
"Members" that include competitors and suppliers (1)	❍	❍	❍	❍	❍
"Members" that include industry associations and professional networks (2)	❍	❍	❍	❍	❍
An easy to use website (3)	❍	❍	❍	❍	❍
"Member" only web portal for resources (4)	❍	❍	❍	❍	❍
Single point of contact to match your needs to resources (5)	❍	❍	❍	❍	❍
Annual membership payment with a single fee for all firms (6)	❍	❍	❍	❍	❍
Annual membership payment with tiered payment levels (7)	❍	❍	❍	❍	❍
Access to career services for future employees or interns (8)	❍	❍	❍	❍	❍

Online and distance learning options for employees (9)	❍	❍	❍	❍	❍
Ability to develop tailored education for your employees (10)	❍	❍	❍	❍	❍
Participation in pre-competitive research on materials, engineering and technology (11)	❍	❍	❍	❍	❍
Support to accelerate product or technology that may have a commercialization value (12)	❍	❍	❍	❍	❍
Ability to participate in industry research or projects (13)	❍	❍	❍	❍	❍
Shared-user facilities with state of the art engineering, technology and operations capabilities (14)	❍	❍	❍	❍	❍
Access to students and faculty to do projects on business issues (15)	❍	❍	❍	❍	❍
Conferences and events (16)	❍	❍	❍	❍	❍
Webinars (17)	❍	❍	❍	❍	❍
Discounts to events (18)	❍	❍	❍	❍	❍

A physical office and designated facility (19)	❍	❍	❍	❍	❍
A virtual environment with access to resources on a real-time basis (20)	❍	❍	❍	❍	❍

Q18 Looking forward, how likely would you be to use a regional linkage to a university or community college for the following business issues?

	Very Likely (1)	Likely (2)	Undecided (3)	Unlikely (4)	Very Unlikely (5)
Product development (1)	❍	❍	❍	❍	❍
Materials science and testing (2)	❍	❍	❍	❍	❍
Mechanical engineering (3)	❍	❍	❍	❍	❍
Product design (4)	❍	❍	❍	❍	❍
Lean manufacturing process (5)	❍	❍	❍	❍	❍
Waste reduction and closed loop process design (6)	❍	❍	❍	❍	❍
Environmental Risk Analysis (7)	❍	❍	❍	❍	❍
Business planning (8)	❍	❍	❍	❍	❍
Financial modeling (9)	❍	❍	❍	❍	❍
Inventory management strategies (10)	❍	❍	❍	❍	❍
Operations analysis (11)	❍	❍	❍	❍	❍
Market research on customers and market segments (12)	❍	❍	❍	❍	❍
Communications/advertising (13)	❍	❍	❍	❍	❍
Staff training (14)	❍	❍	❍	❍	❍
Career services - professional hires (15)	❍	❍	❍	❍	❍
Career services - technical hires (16)	❍	❍	❍	❍	❍

Q19 A collaboratory such as the NWSCM could be set up to achieve a number of different benefits. How would you rank the following benefits from this kind of an organization? Click and drag the ideas up/down to rank them.

_____ Provide research resources to help your company's R&D initiatives (1)
_____ Support your company seek as it seeks grants from government agencies (2)
_____ Build economic development in the industry across the region (3)
_____ Support advocacy and public policy discussions at the state, regional and local levels (4)
_____ Build connections between companies in the industry that can be developed into sales and marketing opportunities (5)
_____ Enable universities to seek grants that build capacity to support current and emerging technological needs of your industry (6)
_____ Enable universities to seek grants that build capacity to support current and emerging business problem-solving and benchmarking needs of your industry (7)
_____ Attract and retain skilled and trained employees to the industry (8)
_____ Facilitate collaboration between faculty across OUS schools and WSU-V (9)

Q20 Overall does the concept of the NWCSM appeal to you to support your technological or business needs?

- ❍ Yes (1)
- ❍ No (2)
- ❍ Not Sure (3)

Q21 What information would you need to know more about to make this concept more appealing?

Q22 The following questions are used for statistical tabulation purposes only:

Q23 How large is your company in terms of total revenue?

- ❍ Less Than $500,000 (1)
- ❍ $500,000-1 Million (2)
- ❍ $1-2.5 Million (3)
- ❍ $2.5-5 Million (4)
- ❍ $5-10 Million (5)
- ❍ $10-20 Million (6)
- ❍ $20-50 Million (7)
- ❍ $50-100 Million (8)
- ❍ $100-500 Million (9)
- ❍ $500m - $1 Billion (10)
- ❍ Prefer Not to Answer (11)

Q24 In which county are you located? Select the county from the drop down list.

- ❍ Oregon - Baker County (1)
- ❍ Oregon - Benton County (2)
- ❍ Oregon - Clackamas County (3)
- ❍ Oregon - Clatsop County (4)
- ❍ Oregon - Columbia County (5)
- ❍ Oregon - Coos County (6)
- ❍ Oregon - Crook County (7)
- ❍ Oregon - Curry County (8)
- ❍ Oregon - Deschutes County (9)
- ❍ Oregon - Douglas County (10)
- ❍ Oregon - Gilliam County (11)
- ❍ Oregon - Grant County (12)
- ❍ Oregon - Harney County (13)
- ❍ Oregon - Hood River County (14)
- ❍ Oregon - Jackson County (15)
- ❍ Oregon - Jefferson County (16)
- ❍ Oregon - Josephine County (17)
- ❍ Oregon - Klamath County (18)
- ❍ Oregon - Lake County (19)
- ❍ Oregon - Lane County (20)
- ❍ Oregon - Lincoln County (21)
- ❍ Oregon - Linn County (22)
- ❍ Oregon - Malheur County (23)
- ❍ Oregon - Marion County (24)
- ❍ Oregon - Morrow County (25)
- ❍ Oregon - Multnomah County (26)
- ❍ Oregon - Polk County (27)
- ❍ Oregon - Sherman County (28)
- ❍ Oregon - Tillamook County (29)
- ❍ Oregon - Umatilla County (30)
- ❍ Oregon - Union County (31)
- ❍ Oregon - Wallowa County (32)
- ❍ Oregon - Wasco County (33)
- ❍ Oregon - Washington County (34)
- ❍ Oregon - Wheeler County (35)
- ❍ Oregon - Yamhill County (36)
- ❍ Washington - Adams County (37)
- ❍ Washington - Asotin County (38)
- ❍ Washington - Benton County (39)

- Washington - Chelan County (40)
- Washington - Clallam County (41)
- Washington - Clark County (42)
- Washington - Columbia County (43)
- Washington - Cowlitz County (44)
- Washington - Douglas County (45)
- Washington - Ferry County (46)
- Washington - Franklin County (47)
- Washington - Garfield County (48)
- Washington - Grant County (49)
- Washington - Grays Harbor County (50)
- Washington - Island County (51)
- Washington - Jefferson County (52)
- Washington - King County (53)
- Washington - Kitsap County (54)
- Washington - Kittitas County (55)
- Washington - Klickitat County (56)
- Washington - Lewis County (57)
- Washington - Lincoln County (58)
- Washington - Mason County (59)
- Washington - Okanogan County (60)
- Washington - Pacific County (61)
- Washington - Pend Oreille County (62)
- Washington - Pierce County (63)
- Washington - San Juan County (64)
- Washington - Skagit County (65)
- Washington - Skamania County (66)
- Washington - Snohomish County (67)
- Washington - Spokane County (68)
- Washington - Stevens County (69)
- Washington - Thurston County (70)
- Washington - Wahkiakum County (71)
- Washington - Walla Walla County (72)
- Washington - Whatcom County (73)
- Washington - Whitman County (74)
- Washington - Yakima County (75)

Q25 How large is your company in terms of total employees?

- ❍ 1 to 4 (1)
- ❍ 5 to 9 (2)
- ❍ 10 to 19 (3)
- ❍ 20 to 49 (4)
- ❍ 50 - 99 (5)
- ❍ 100 to 249 (6)
- ❍ 250 to 499 (7)
- ❍ 500 to 999 (8)
- ❍ 1000 to 4999 (9)
- ❍ Prefer Not to Answer (10)

Q26 Which of the following best describes your current position?

- ❍ Executive, e .g CEO, COO, CFO (1)
- ❍ Business Unit Director (2)
- ❍ Operations (3)
- ❍ Sales (4)
- ❍ Other (5)

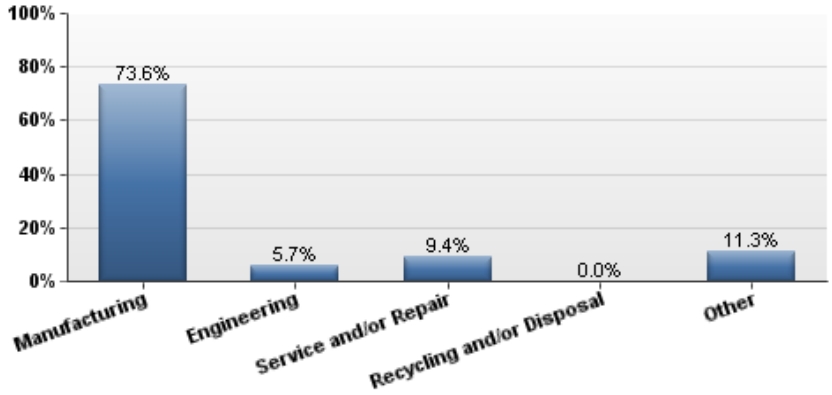
Q27 Thank you for your time and input. If there is anything you would like to know more about or if you have any questions, please feel free to enter your question below and put in your email address so we can get back to you.

APPENDIX E: ON-LINE SURVEY RESULTS FROM REGIONWIDE TARGET POPULATION

NWSCM Online Survey Results

Generated: 10/28/2012

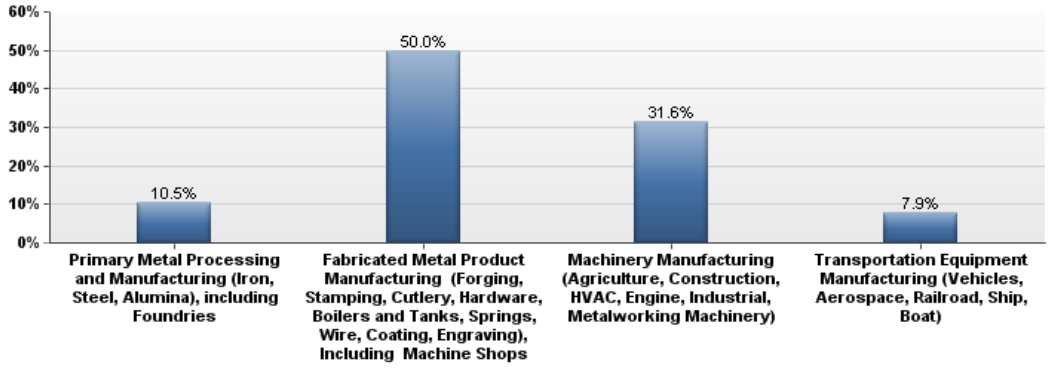
1. Which business segment best describes your company's primary business focus?



#	Answer		Response	%
1	Manufacturing		39	74%
2	Engineering		3	6%
3	Service and/or Repair		5	9%
4	Recycling and/or Disposal		0	0%
5	Other		6	11%
	Total		53	100%

Statistic	Value
Min Value	1
Max Value	5
Mean	1.70
Variance	1.79
Standard Deviation	1.34
Total Responses	53

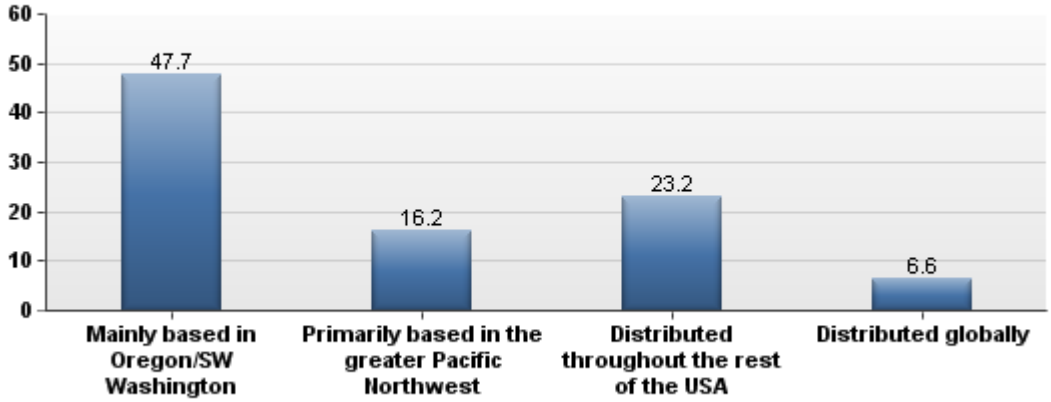
2. Which of the following sectors of the metals manufacturing industry best describes your business?



#	Answer		Response	%
1	Primary Metal Processing and Manufacturing (Iron, Steel, Alumina), including Foundries		4	11%
2	Fabricated Metal Product Manufacturing (Forging, Stamping, Cutlery, Hardware, Boilers and Tanks, Springs, Wire, Coating, Engraving), Including Machine Shops		19	50%
3	Machinery Manufacturing (Agriculture, Construction, HVAC, Engine, Industrial, Metalworking Machinery)		12	32%
4	Transportation Equipment Manufacturing (Vehicles, Aerospace, Railroad, Ship, Boat)		3	8%
	Total		38	100%

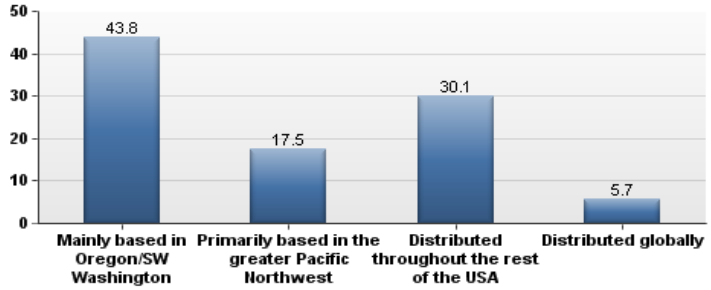
Statistic	Value
Min Value	1
Max Value	4
Mean	2.37
Variance	0.62
Standard Deviation	0.79
Total Responses	38

3. Approximately what percent of your key suppliers are located in the following areas?



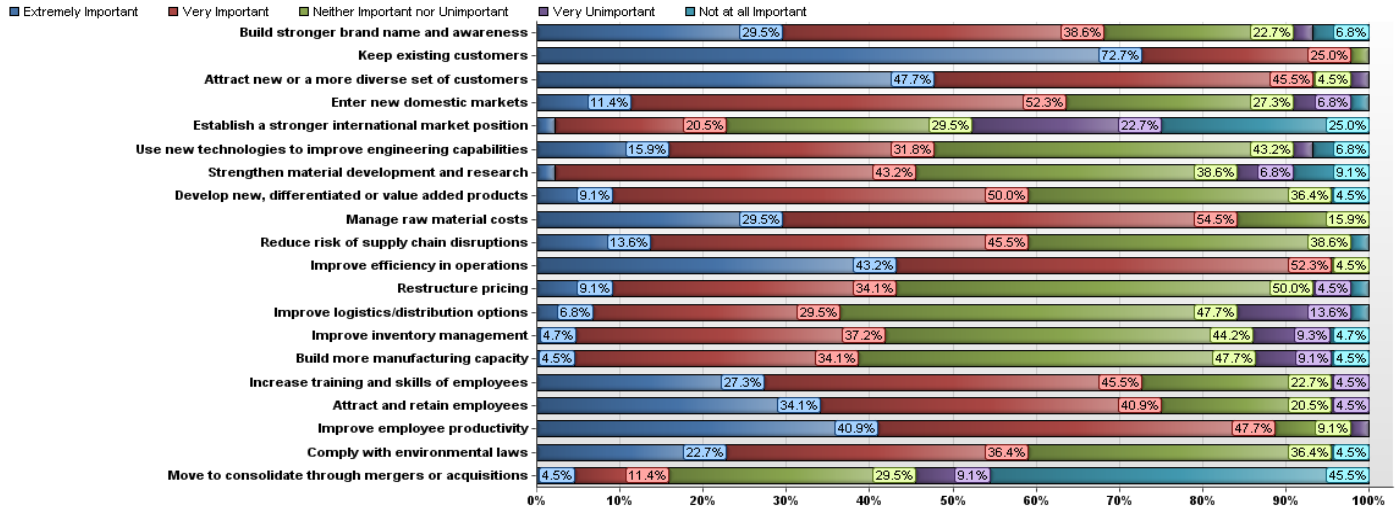
#	Answer	Min Value	Max Value	Average Value	Standard Deviation
1	Mainly based in Oregon/SW Washington	0.00	100.00	47.70	35.67
2	Primarily based in the greater Pacific Northwest	0.00	90.00	16.16	21.70
3	Distributed throughout the rest of the USA	0.00	100.00	23.22	24.85
4	Distributed globally	0.00	100.00	6.61	17.66

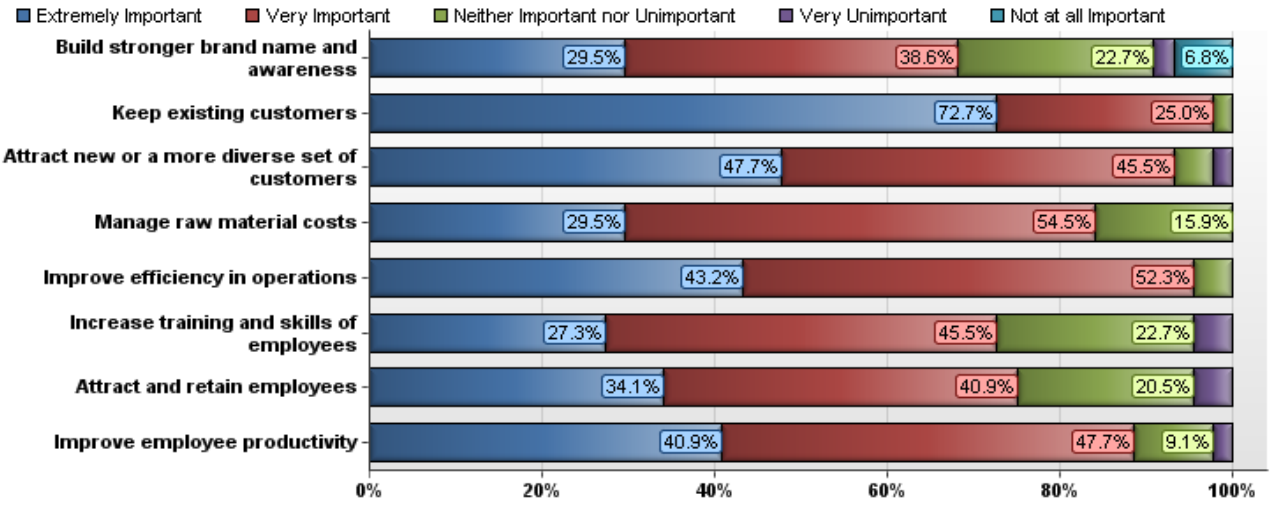
4. Approximately what percent of your firm's customers are located in these areas?



#	Answer	Min Value	Max Value	Average Value	Standard Deviation
1	Mainly based in Oregon/SW Washington	0.00	100.00	43.76	37.99
2	Primarily based in the greater Pacific Northwest	0.00	95.00	17.52	23.63
3	Distributed throughout the rest of the USA	0.00	95.00	30.14	30.99
4	Distributed globally	0.00	45.00	5.66	10.74

5. How important are each of the issues facing your own company's competitive success over the next three years?





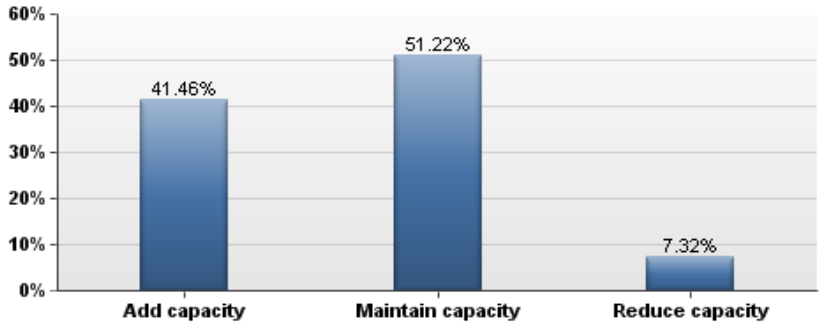
#	Question	Extremely Important	Very Important	Neither Important nor Unimportant	Very Unimportant	Not at all Important	Responses	Mean
2	Keep existing customers	72.7%	25.0%	2.3%	0.0%	0.0%	44	1.3
3	Attract new or a more diverse set of customers	47.7%	45.5%	4.5%	2.3%	0.0%	44	1.6
11	Improve efficiency in operations	43.2%	52.3%	4.5%	0.0%	0.0%	44	1.6
18	Improve employee productivity	40.9%	47.7%	9.1%	2.3%	0.0%	44	1.7
17	Attract and retain employees	34.1%	40.9%	20.5%	4.5%	0.0%	44	2.0
1	Build stronger brand name and awareness	29.5%	38.6%	22.7%	2.3%	6.8%	44	2.2
9	Manage raw material costs	29.5%	54.5%	15.9%	0.0%	0.0%	44	1.9
16	Increase training and skills of employees	27.3%	45.5%	22.7%	4.5%	0.0%	44	2.0
19	Comply with environmental laws	22.7%	36.4%	36.4%	0.0%	4.5%	44	2.3
6	Use new technologies to improve engineering capabilities	15.9%	31.8%	43.2%	2.3%	6.8%	44	2.5
10	Reduce risk of supply chain disruptions	13.6%	45.5%	38.6%	0.0%	2.3%	44	2.3
4	Enter new domestic markets	11.4%	52.3%	27.3%	6.8%	2.3%	44	2.4
12	Restructure pricing	9.1%	34.1%	50.0%	4.5%	2.3%	44	2.6
8	Develop new, differentiated or value added products	9.1%	50.0%	36.4%	0.0%	4.5%	44	2.4

13	Improve logistics/distribution options	6.8%	29.5%	47.7%	13.6%	2.3%	44	2.8
14	Improve inventory management	4.7%	37.2%	44.2%	9.3%	4.7%	43	2.7
20	Move to consolidate through mergers or acquisitions	4.5%	11.4%	29.5%	9.1%	45.5%	44	3.8
15	Build more manufacturing capacity	4.5%	34.1%	47.7%	9.1%	4.5%	44	2.8
7	Strengthen material development and research	2.3%	43.2%	38.6%	6.8%	9.1%	44	2.8
5	Establish a stronger international market position	2.3%	20.5%	29.5%	22.7%	25.0%	44	3.5

#	Question	Extremely Important	Very Important	Neither Important nor Unimportant	Very Unimportant	Not at all Important	Responses	Mean
2	Keep existing customers	32	11	1	0	0	44	1.30
3	Attract new or a more diverse set of customers	21	20	2	1	0	44	1.61
11	Improve efficiency in operations	19	23	2	0	0	44	1.61
18	Improve employee productivity	18	21	4	1	0	44	1.73
17	Attract and retain employees	15	18	9	2	0	44	1.95
1	Build stronger brand name and awareness	13	17	10	1	3	44	2.18
9	Manage raw material costs	13	24	7	0	0	44	1.86

16	Increase training and skills of employees	12	20	10	2	0	44	2.05
19	Comply with environmental laws	10	16	16	0	2	44	2.27
6	Use new technologies to improve engineering capabilities	7	14	19	1	3	44	2.52
10	Reduce risk of supply chain disruptions	6	20	17	0	1	44	2.32
4	Enter new domestic markets	5	23	12	3	1	44	2.36
12	Restructure pricing	4	15	22	2	1	44	2.57
8	Develop new, differentiated or value added products	4	22	16	0	2	44	2.41
13	Improve logistics/distribution options	3	13	21	6	1	44	2.75
20	Move to consolidate through mergers or acquisitions	2	5	13	4	20	44	3.80
14	Improve inventory management	2	16	19	4	2	43	2.72
15	Build more manufacturing capacity	2	15	21	4	2	44	2.75
7	Strengthen material development and research	1	19	17	3	4	44	2.77
5	Establish a stronger international market position	1	9	13	10	11	44	3.48

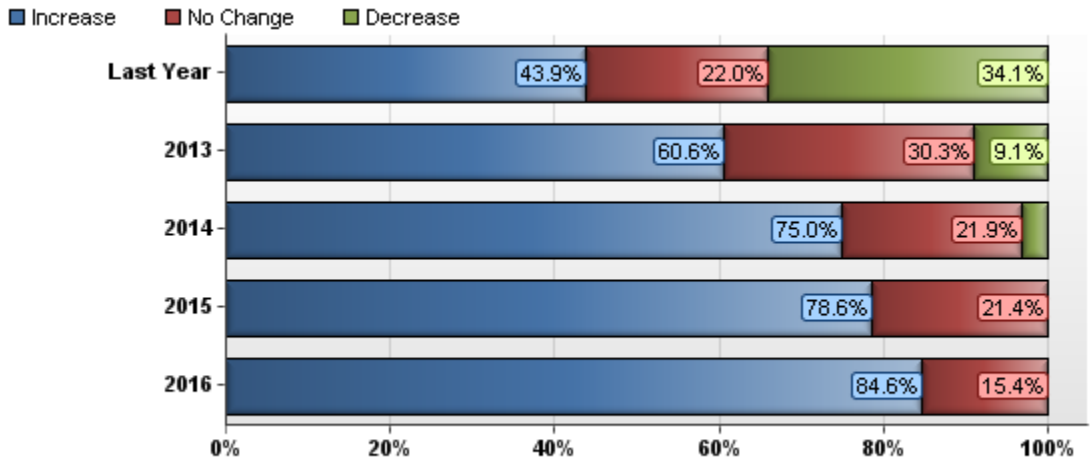
6. Which best describes how you expect to manage the capacity (equipment, technology, employees) of your business during 2013?



#	Answer		Response	%
1	Add capacity		17	41%
2	Maintain capacity		21	51%
3	Reduce capacity		3	7%
	Total		41	100%

Statistic	Value
Min Value	1
Max Value	3
Mean	1.66
Variance	0.38
Standard Deviation	0.62
Total Responses	41

7. How did your company's revenue change over the last year and how do you expect it will change in 2013 and the next three years?

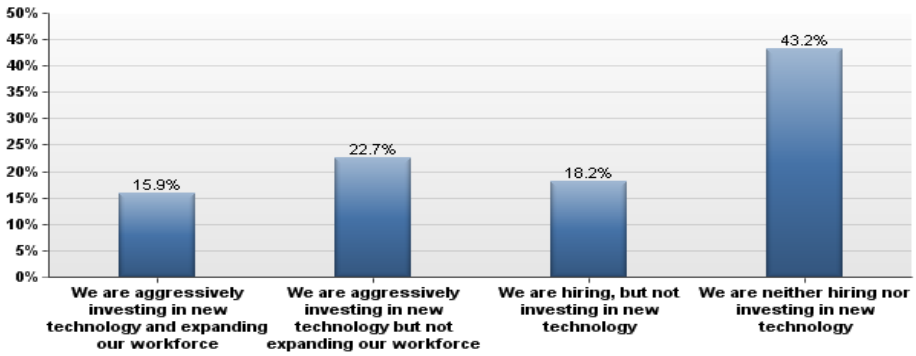


#	Question	Increase	No Change	Decrease	Responses	Mean
1	Last Year	43.9%	22.0%	34.1%	41	1.9
2	2013	60.6%	30.3%	9.1%	33	1.5
3	2014	75.0%	21.9%	3.1%	32	1.3
4	2015	78.6%	21.4%	0.0%	28	1.2
5	2016	84.6%	15.4%	0.0%	26	1.2

#	Question	Increase	No Change	Decrease	Responses	Mean
1	Last Year	18	9	14	41	1.90
2	2013	20	10	3	33	1.48
3	2014	24	7	1	32	1.28
4	2015	22	6	0	28	1.21
5	2016	22	4	0	26	1.15

Statistic	Last Year	2013	2014	2015	2016
Min Value	1	1	1	1	1
Max Value	3	3	3	2	2
Mean	1.90	1.48	1.28	1.21	1.15
Variance	0.79	0.45	0.27	0.17	0.14
Standard Deviation	0.89	0.67	0.52	0.42	0.37
Total Responses	41	33	32	28	26

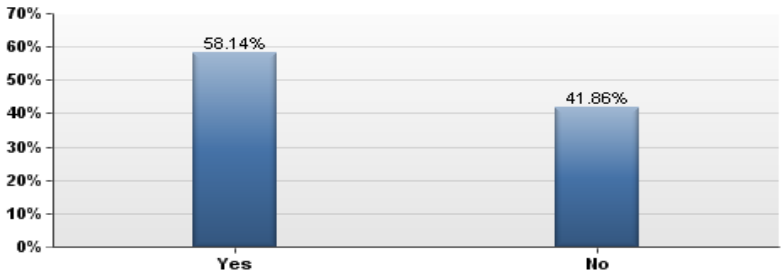
8. Which statement best describes your company's hiring and investment plans for 2013?



#	Answer		Response	%
1	We are aggressively investing in new technology and expanding our workforce		7	16%
2	We are aggressively investing in new technology but not expanding our workforce		10	23%
3	We are hiring, but not investing in new technology		8	18%
4	We are neither hiring nor investing in new technology		19	43%
	Total		44	100%

Statistic	Value
Min Value	1
Max Value	4
Mean	2.89
Variance	1.31
Standard Deviation	1.15
Total Responses	44

9. Are you a member of any industry networks and professional associations?



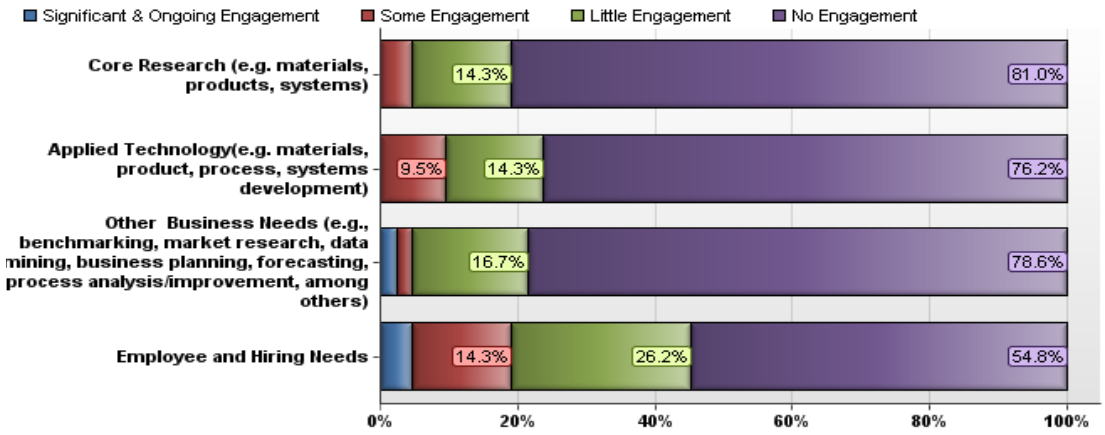
#	Answer		Response	%
1	Yes		25	58%
2	No		18	42%
	Total		43	100%

Statistic	Value
Min Value	1
Max Value	2
Mean	1.42
Variance	0.25
Standard Deviation	0.50
Total Responses	43

10. What are the most important industry networks or professional associations for your firm?

Text Response
NAHB; BOS
None are particularly more important than the others
Packaging machinery manufacturers institute (PMMI)
NFIB
The Society of Plastics Engineers
Lean manufacturing promotion and training ones.
MSCI AWMI PNWFA
Robotic Industries Association (RIA); Association for Manufacturing Excellence (AME)
NW HPEC
NWTMA, SPI, SPE
Mid Willamette High Performance Consortium, Job Growers
ASME, Tappi.AOI
engineering associations, certified weld inspection associations
SME, IEEE
Aircraft Kit Industry Association
AISC, AWS, ICC, OBOA, City of Portland
CSI, DHI, HPLO
Metal Finishers Association
NWTMA

11. What is your current level of your engagement with Universities (i.e., Engineering/Science/Business Schools at OSU, PSU, OIT, UO, or WSU-Vancouver) for supporting any of the following needs?

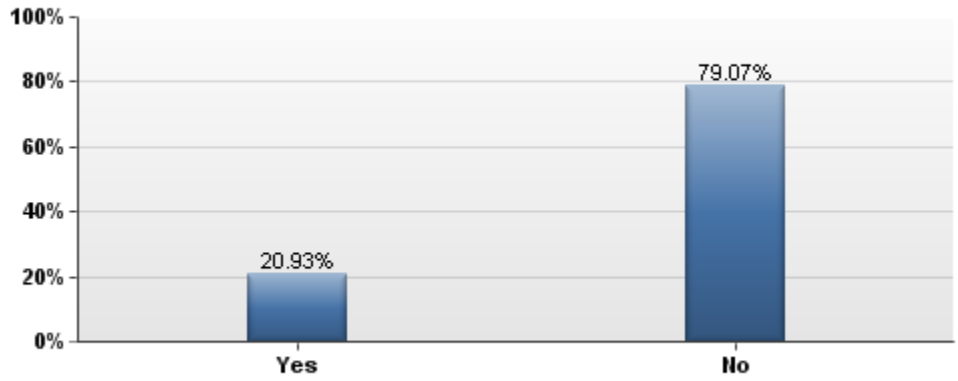


#	Question	Significant & Ongoing Engagement	Some Engagement	Little Engagement	No Engagement	Responses	Mean
1	Core Research (e.g. materials, products, systems)	0.0%	4.8%	14.3%	81.0%	42	3.8
3	Other Business Needs (e.g., benchmarking, market research, data mining, business planning, forecasting, process analysis/improvement, among others)	2.4%	2.4%	16.7%	78.6%	42	3.7
2	Applied Technology(e.g. materials, product, process, systems development)	0.0%	9.5%	14.3%	76.2%	42	3.7
4	Employee and Hiring Needs	4.8%	14.3%	26.2%	54.8%	42	3.3

#	Question	Significant & Ongoing Engagement	Some Engagement	Little Engagement	No Engagement	Responses	Mean
1	Core Research (e.g. materials, products, systems)	0	2	6	34	42	3.76
3	Other Business Needs (e.g., benchmarking, market research, data mining, business planning, forecasting, process analysis/improvement, among others)	1	1	7	33	42	3.71
2	Applied Technology(e.g. materials, product, process, systems development)	0	4	6	32	42	3.67
4	Employee and Hiring Needs	2	6	11	23	42	3.31

Statistic	Core Research (e.g. materials, products, systems)	Applied Technology(e.g. materials, product, process, systems development)	Other Business Needs (e.g., benchmarking, market research, data mining, business planning, forecasting, process analysis/improvement, among others)	Employee and Hiring Needs
Min Value	2	2	1	1
Max Value	4	4	4	4
Mean	3.76	3.67	3.71	3.31
Variance	0.28	0.42	0.40	0.80
Standard Deviation	0.53	0.65	0.64	0.90
Total Responses	42	42	42	42

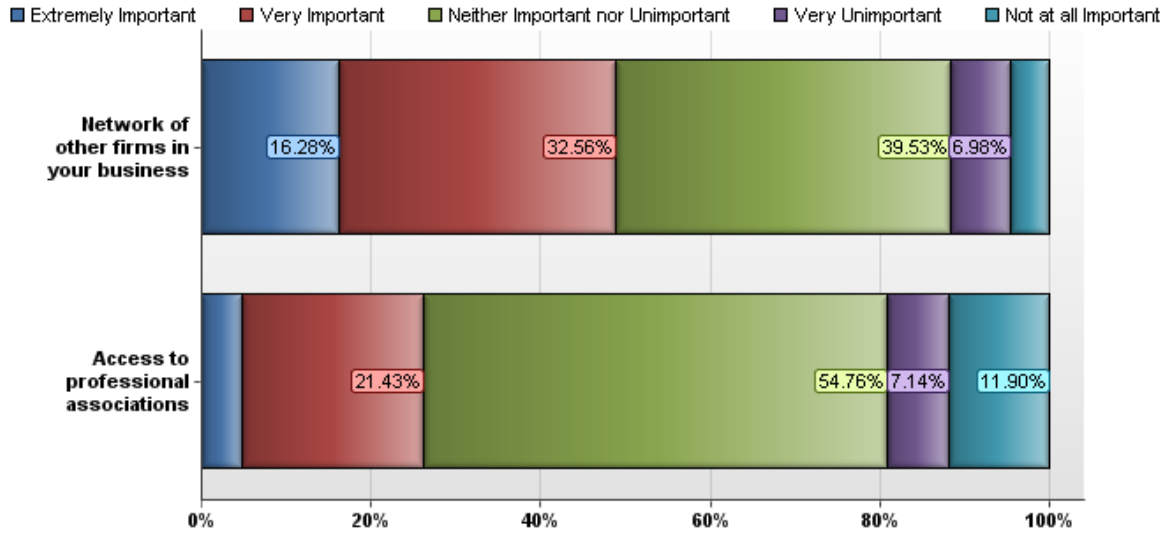
12. In the last year have you contacted your local university or community college to inquire about business assistance?

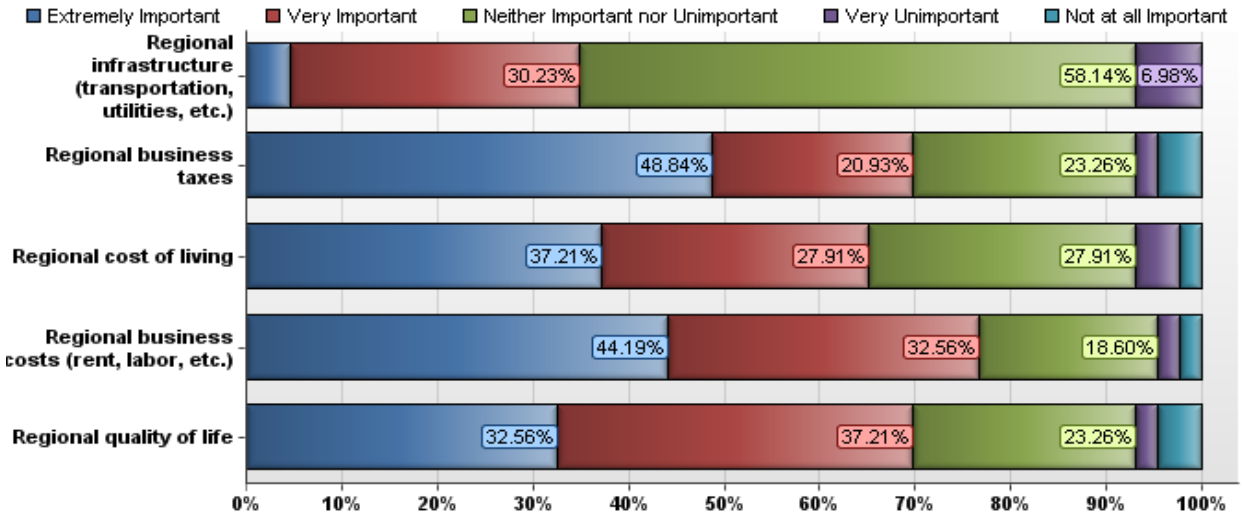


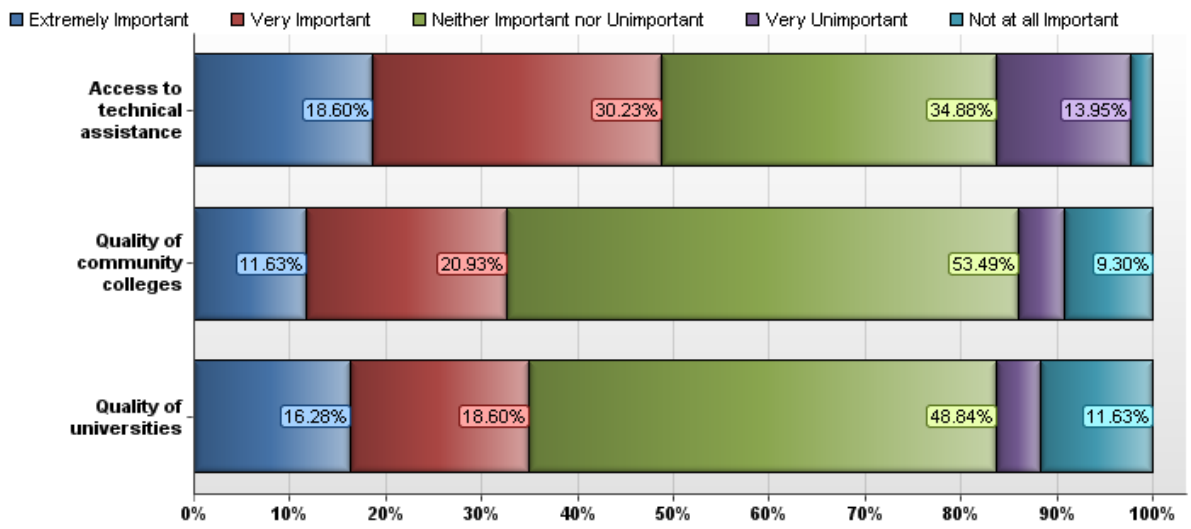
#	Answer		Response	%
1	Yes		9	21%
2	No		34	79%
	Total		43	100%

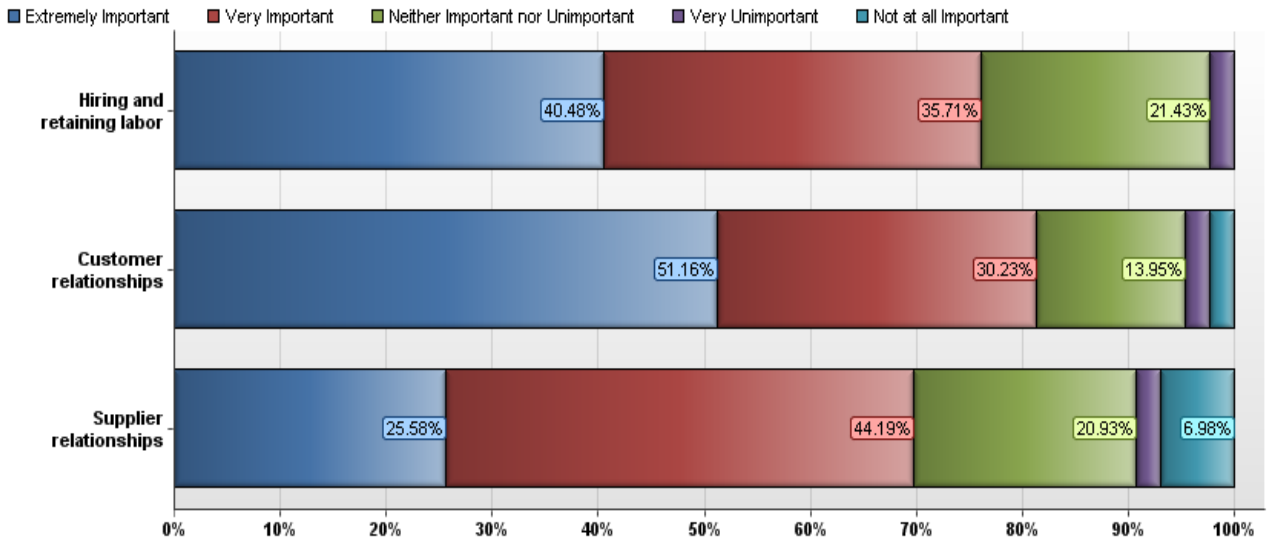
Statistic	Value
Min Value	1
Max Value	2
Mean	1.79
Variance	0.17
Standard Deviation	0.41
Total Responses	43

13. How important are the following benefits of maintaining a location in Oregon/SW Washington in keeping your organization competitive?









#	Question	Extremely Important	Very Important	Neither Important nor Unimportant	Very Unimportant	Not at all Important	Responses	Mean
2	Customer relationships	51.2%	30.2%	14.0%	2.3%	2.3%	43	1.7
8	Regional business taxes	48.8%	20.9%	23.3%	2.3%	4.7%	43	1.9

10	Regional business costs (rent, labor, etc.)	44.2%	32.6%	18.6%	2.3%	2.3%	43	1.9
1	Hiring and retaining labor	40.5%	35.7%	21.4%	2.4%	0.0%	42	1.9
9	Regional cost of living	37.2%	27.9%	27.9%	4.7%	2.3%	43	2.1
11	Regional quality of life	32.6%	37.2%	23.3%	2.3%	4.7%	43	2.1
3	Supplier relationships	25.6%	44.2%	20.9%	2.3%	7.0%	43	2.2
4	Access to technical assistance	18.6%	30.2%	34.9%	14.0%	2.3%	43	2.5
12	Network of other firms in your business	16.3%	32.6%	39.5%	7.0%	4.7%	43	2.5
6	Quality of universities	16.3%	18.6%	48.8%	4.7%	11.6%	43	2.8
5	Quality of community colleges	11.6%	20.9%	53.5%	4.7%	9.3%	43	2.8
13	Access to professional associations	4.8%	21.4%	54.8%	7.1%	11.9%	42	3.0
7	Regional infrastructure (transportation, utilities, etc.)	4.7%	30.2%	58.1%	7.0%	0.0%	43	2.7

#	Question	Extremely Important	Very Important	Neither Important nor Unimportant	Very Unimportant	Not at all Important	Responses	Mean
1	Hiring and retaining labor	17	15	9	1	0	42	1.86
2	Customer relationships	22	13	6	1	1	43	1.74
3	Supplier relationships	11	19	9	1	3	43	2.21
4	Access to technical assistance	8	13	15	6	1	43	2.51

5	Quality of community colleges	5	9	23	2	4	43	2.79
6	Quality of universities	7	8	21	2	5	43	2.77
7	Regional infrastructure (transportation, utilities, etc.)	2	13	25	3	0	43	2.67
8	Regional business taxes	21	9	10	1	2	43	1.93
9	Regional cost of living	16	12	12	2	1	43	2.07
10	Regional business costs (rent, labor, etc.)	19	14	8	1	1	43	1.86
11	Regional quality of life	14	16	10	1	2	43	2.09
12	Network of other firms in your business	7	14	17	3	2	43	2.51
13	Access to professional associations	2	9	23	3	5	42	3.00

14. What prompted you to call?

Text Response
RFP
Sale of business
Training Services
Being an alumni and being familiar with the schools' offerings
In 2009 when the Chinese signed in there 5 year subsidy program we lost 60% of our work load this was on top of the 15% in the 2008 down turn. We ask and implemented many ideas form, Chamber of Commerce, BBB, multiple assoc. programs and Government Programs. The Department of Commerce, Economic Development Division told us to think outside the box and change or paradigm to shift in to a new path developing out of our existing machine tool trade. Saying our industry was not being supported by any Trade Adjustment Assistance and with 75% of our customer base gone they suggested we move on to something different. I myself have attended O.I.T. (1974-1977) became a Mfg. Eng. in 1991, finally taking advantage of my education. Then started my own business 9-12-94 had growth up to 2002 employing 8-12 people, today we are at 4 and have stabilized for now. Still need help combating the off shore subsidy which allowed the China Mfg. to quote a price for 5 years when are price of raw materials changes monthly. How do we combat against a 5 year price guarantee ??????
Need for re-financing of the business
Need for machinists
Was called by Corporate Relations and try and stay in contact with Welding & Machining instructors.

15. Did you get the assistance you were looking for?

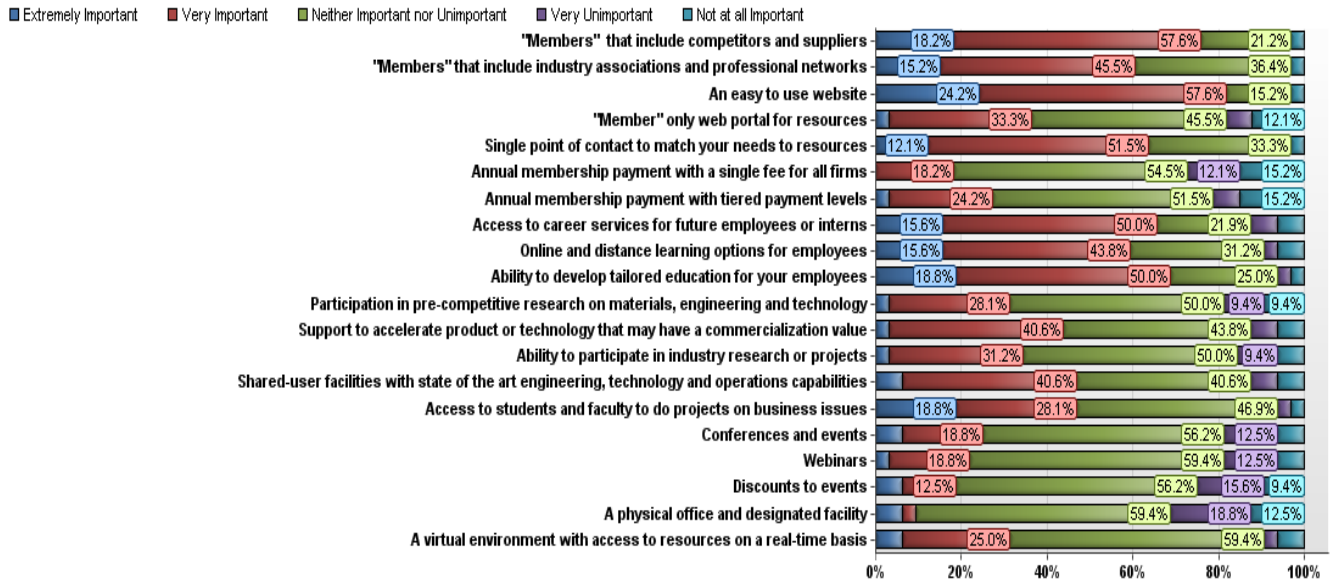
Text Response
No
yes
yes
For hiring, yes. For project help, yes. For partnering, not really.
NO, read previous comment.
It is in process, whether the plan being worked on is successful remains to be seen. It is turning out to be a rather long process.
no
yes. But need to continue to get qualified employees.

16. Looking forward, how likely would you be to use a regional linkage to a university or community college for the following business issues?

#	Question	Very Likely	Likely	Undecided	Unlikely	Very Unlikely	Responses	Mean
16	Career services - technical hires	16.1%	35.5%	25.8%	12.9%	9.7%	31	2.6
3	Mechanical engineering	15.6%	28.1%	28.1%	18.8%	9.4%	32	2.8
14	Staff training	12.9%	32.3%	22.6%	12.9%	19.4%	31	2.9
5	Lean manufacturing process	12.9%	19.4%	32.3%	16.1%	19.4%	31	3.1
12	Market research on customers and market segments	12.9%	29.0%	22.6%	19.4%	16.1%	31	3.0
15	Career services - professional hires	10.0%	23.3%	36.7%	20.0%	10.0%	30	3.0
13	Communications/advertising	9.7%	16.1%	35.5%	22.6%	16.1%	31	3.2
2	Materials science and testing	9.4%	25.0%	18.8%	28.1%	18.8%	32	3.2
8	Business planning	6.5%	29.0%	35.5%	19.4%	9.7%	31	3.0
6	Waste reduction and closed loop process design	6.5%	25.8%	32.3%	16.1%	19.4%	31	3.2
9	Financial modeling	3.2%	22.6%	32.3%	32.3%	9.7%	31	3.2
7	Environmental Risk Analysis	3.2%	25.8%	32.3%	22.6%	16.1%	31	3.2
10	Inventory management strategies	3.2%	22.6%	35.5%	22.6%	16.1%	31	3.3
11	Operations analysis	3.2%	29.0%	32.3%	19.4%	16.1%	31	3.2
1	Product development	3.1%	15.6%	31.3%	18.8%	31.3%	32	3.6
4	Product design	3.1%	18.8%	34.4%	21.9%	21.9%	32	3.4

#	Question	Very Likely	Likely	Undecided	Unlikely	Very Unlikely	Responses	Mean
1	Product development	1	5	10	6	10	32	3.59
2	Materials science and testing	3	8	6	9	6	32	3.22
3	Mechanical engineering	5	9	9	6	3	32	2.78
4	Product design	1	6	11	7	7	32	3.41
5	Lean manufacturing process	4	6	10	5	6	31	3.10
6	Waste reduction and closed loop process design	2	8	10	5	6	31	3.16
7	Environmental Risk Analysis	1	8	10	7	5	31	3.23
8	Business planning	2	9	11	6	3	31	2.97
9	Financial modeling	1	7	10	10	3	31	3.23
10	Inventory management strategies	1	7	11	7	5	31	3.26
11	Operations analysis	1	9	10	6	5	31	3.16
12	Market research on customers and market segments	4	9	7	6	5	31	2.97
13	Communications/advertising	3	5	11	7	5	31	3.19
14	Staff training	4	10	7	4	6	31	2.94
15	Career services - professional hires	3	7	11	6	3	30	2.97
16	Career services - technical hires	5	11	8	4	3	31	2.65

17. If a Collaboratory was set up in the region focused on metals manufacturing firms, how important would each of the following be in your company's decision to participate?



#	Question	Extremely Important	Very Important	Neither Important nor Unimportant	Very Unimportant	Not at all Important	Responses	Mean
3	An easy to use website	24.2%	57.6%	15.2%	0.0%	3.0%	33	2.0
15	Access to students and faculty to do projects on business issues	18.8%	28.1%	46.9%	3.1%	3.1%	32	2.4
10	Ability to develop tailored education for your employees	18.8%	50.0%	25.0%	3.1%	3.1%	32	2.2
1	"Members" that include competitors and suppliers	18.2%	57.6%	21.2%	0.0%	3.0%	33	2.1

8	Access to career services for future employees or interns	15.6%	50.0%	21.9%	6.3%	6.3%	32	2.4
9	Online and distance learning options for employees	15.6%	43.8%	31.3%	3.1%	6.3%	32	2.4
2	"Members" that include industry associations and professional networks	15.2%	45.5%	36.4%	0.0%	3.0%	33	2.3
5	Single point of contact to match your needs to resources	12.1%	51.5%	33.3%	0.0%	3.0%	33	2.3
14	Shared-user facilities with state of the art engineering, technology and operations capabilities	6.3%	40.6%	40.6%	6.3%	6.3%	32	2.7
16	Conferences and events	6.3%	18.8%	56.3%	12.5%	6.3%	32	2.9
18	Discounts to events	6.3%	12.5%	56.3%	15.6%	9.4%	32	3.1
19	A physical office and designated facility	6.3%	3.1%	59.4%	18.8%	12.5%	32	3.3
20	A virtual environment with access to resources on a real-time basis	6.3%	25.0%	59.4%	3.1%	6.3%	32	2.8
17	Webinars	3.1%	18.8%	59.4%	12.5%	6.3%	32	3.0
12	Support to accelerate product or technology that may have a commercializatio n value	3.1%	40.6%	43.8%	6.3%	6.3%	32	2.7

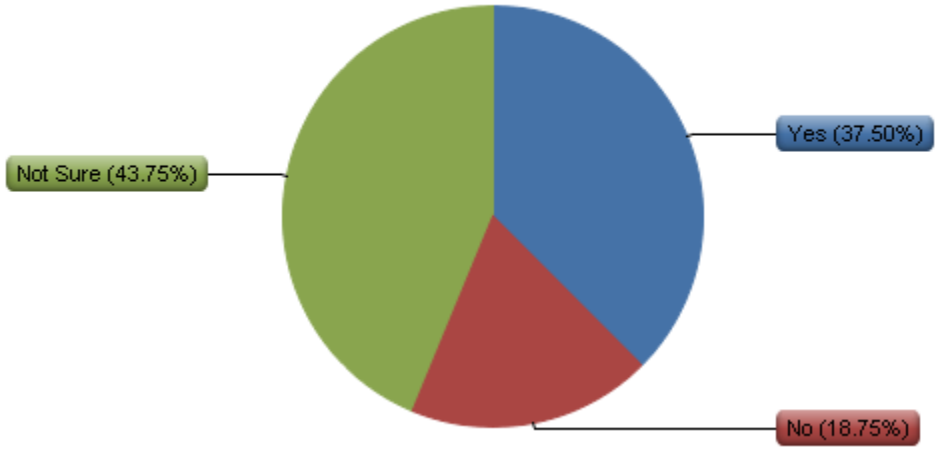
13	Ability to participate in industry research or projects	3.1%	31.3%	50.0%	9.4%	6.3%	32	2.8
11	Participation in pre-competitive research on materials, engineering and technology	3.1%	28.1%	50.0%	9.4%	9.4%	32	2.9
4	"Member" only web portal for resources	3.0%	33.3%	45.5%	6.1%	12.1%	33	2.9
7	Annual membership payment with tiered payment levels	3.0%	24.2%	51.5%	6.1%	15.2%	33	3.1
6	Annual membership payment with a single fee for all firms	0.0%	18.2%	54.5%	12.1%	15.2%	33	3.2

#	Question	Extremely Important	Very Important	Neither Important nor Unimportant	Very Unimportant	Not at all Important	Responses	Mean
1	"Members" that include competitors and suppliers	6	19	7	0	1	33	2.12
2	"Members" that include industry associations and professional networks	5	15	12	0	1	33	2.30
3	An easy to use website	8	19	5	0	1	33	2.00
4	"Member" only web portal for resources	1	11	15	2	4	33	2.91
5	Single point of contact to match your needs to resources	4	17	11	0	1	33	2.30

6	Annual membership payment with a single fee for all firms	0	6	18	4	5	33	3.24
7	Annual membership payment with tiered payment levels	1	8	17	2	5	33	3.06
8	Access to career services for future employees or interns	5	16	7	2	2	32	2.38
9	Online and distance learning options for employees	5	14	10	1	2	32	2.41
10	Ability to develop tailored education for your employees	6	16	8	1	1	32	2.22
11	Participation in pre-competitive research on materials, engineering and technology	1	9	16	3	3	32	2.94
12	Support to accelerate product or technology that may have a commercializatio n value	1	13	14	2	2	32	2.72
13	Ability to participate in industry research or projects	1	10	16	3	2	32	2.84
14	Shared-user facilities with state of the art engineering, technology and operations capabilities	2	13	13	2	2	32	2.66

15	Access to students and faculty to do projects on business issues	6	9	15	1	1	32	2.44
16	Conferences and events	2	6	18	4	2	32	2.94
17	Webinars	1	6	19	4	2	32	3.00
18	Discounts to events	2	4	18	5	3	32	3.09
19	A physical office and designated facility	2	1	19	6	4	32	3.28
20	A virtual environment with access to resources on a real-time basis	2	8	19	1	2	32	2.78

18. Overall does the concept of the NWCSM appeal to you to support your technological or business needs?



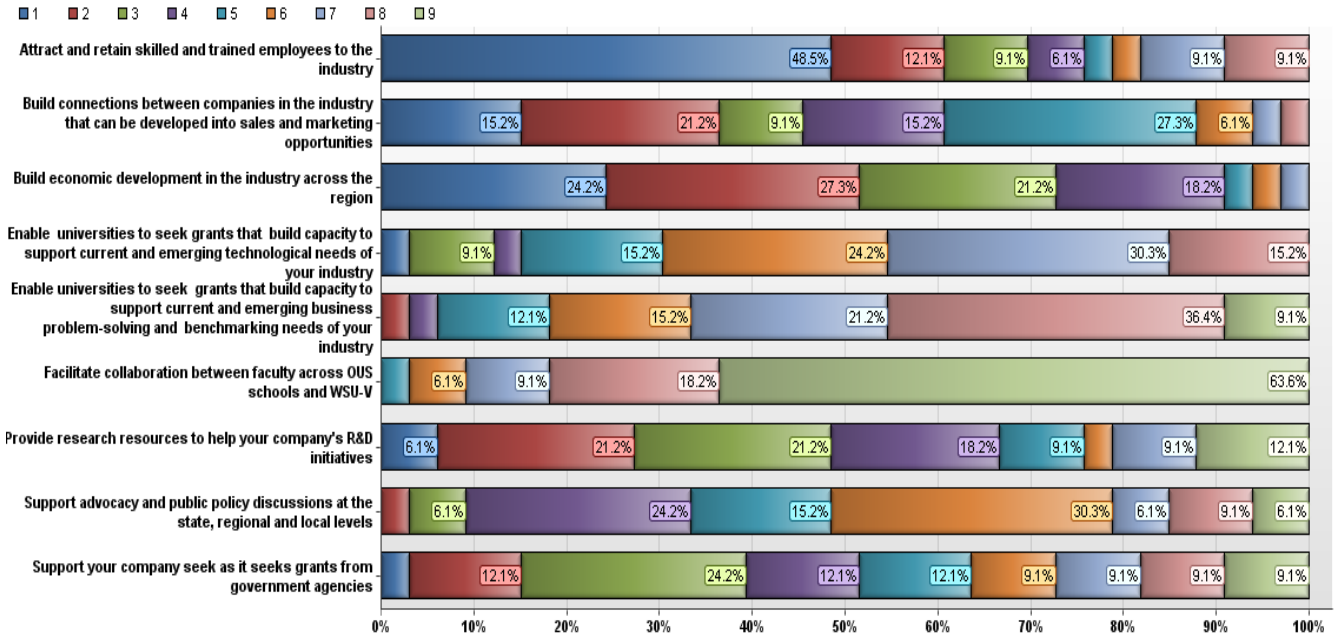
#	Answer		Response	%
1	Yes		12	38%
2	No		6	19%
3	Not Sure		14	44%
	Total		32	100%

Statistic	Value
Min Value	1
Max Value	3
Mean	2.06
Variance	0.83
Standard Deviation	0.91
Total Responses	32

19. What information would you need to know more about to make this concept more appealing?

Text Response
What kind of practical, tangible involvement there would be in providing/improving technical skills of the local workforce
What we really need is access to mechanical engineers, and design engineers or firms that can supply that expertise, fast with a minimal amount of ramp up time. As in, "Here is what we need this to do...this is what we want to make it out of...here is what the hard dollar cost needs to be". That sort of engagement. "Doers" not "Dreamers" because we want to get to market quickly.
not sure
none
how it would help a small one man machine shop
How many competing organizations are doing the same thing? Even they are just doing tangential things, how many organizations do I need to be a part of to manage?
We have the structure, we need the information in a shareable structure for our members(NWTMA) Which are local tool makers/moldmakers, as technology changes, industry has to tool up for it, so they need us toolmakers to do it!
price and location
Tell us how to combat the 5 year subsidy program with the little money we have left.?? An you will become the most appealing thing ever introduce to us.
concrete ideas and plans
Mission of the organization. Training of employee pool
Cost
Likely cost and time frame to completion.
An executive summary of potential service offered and their priorities
not interested in it.

20. A collaboratory such as the NWSCM could be set up to achieve a number of different benefits. How would you rank the following benefits from this kind of an organization? Click and drag the ideas up/down to rank them.



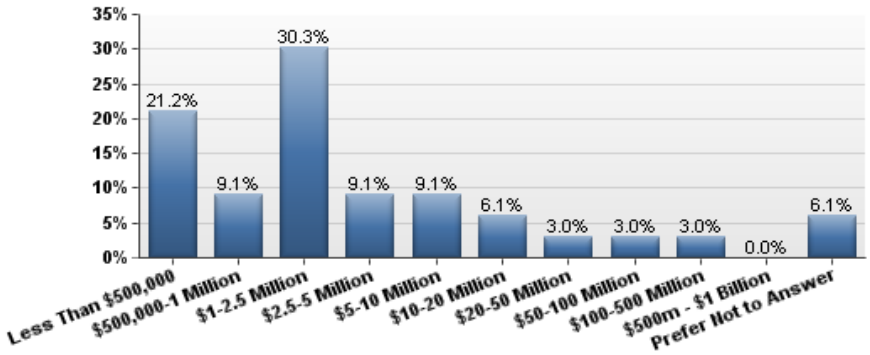
#	Answer	1	2	3	4	5	6	7	8	9	Responses
8	Attract and retain skilled and trained employees to the industry	48.5%	12.1%	9.1%	6.1%	3.0%	3.0%	9.1%	9.1%	0.0%	33
3	Build economic development in the industry across the region	24.2%	27.3%	21.2%	18.2%	3.0%	3.0%	3.0%	0.0%	0.0%	33
5	Build connections between companies in the industry that can be developed into sales and marketing opportunities	15.2%	21.2%	9.1%	15.2%	27.3%	6.1%	3.0%	3.0%	0.0%	33
1	Provide research resources to help your company's R&D initiatives	6.1%	21.2%	21.2%	18.2%	9.1%	3.0%	9.1%	0.0%	12.1%	33

2	Support your company seek as it seeks grants from government agencies	3.0%	12.1%	24.2%	12.1%	12.1%	9.1%	9.1%	9.1%	9.1%	33
6	Enable universities to seek grants that build capacity to support current and emerging technological needs of your industry	3.0%	0.0%	9.1%	3.0%	15.2%	24.2%	30.3%	15.2%	0.0%	33
9	Facilitate collaboration between faculty across OUS schools and WSU-V	0.0%	0.0%	0.0%	0.0%	3.0%	6.1%	9.1%	18.2%	63.6%	33
4	Support advocacy and public policy discussions at the state, regional and local levels	0.0%	3.0%	6.1%	24.2%	15.2%	30.3%	6.1%	9.1%	6.1%	33
7	Enable universities to seek grants that build capacity to support current and emerging business problem-solving and benchmarking needs of your industry	0.0%	3.0%	0.0%	3.0%	12.1%	15.2%	21.2%	36.4%	9.1%	33
	Total	33	33	33	33	33	33	33	33	33	-

#	Answer	1	2	3	4	5	6	7	8	9	Responses
1	Provide research resources to help your company's R&D initiatives	2	7	7	6	3	1	3	0	4	33
2	Support your company seek as it seeks grants from government agencies	1	4	8	4	4	3	3	3	3	33
3	Build economic development in the industry across the region	8	9	7	6	1	1	1	0	0	33
4	Support advocacy and public policy discussions at the state, regional and local levels	0	1	2	8	5	10	2	3	2	33

5	Build connections between companies in the industry that can be developed into sales and marketing opportunities	5	7	3	5	9	2	1	1	0	33
6	Enable universities to seek grants that build capacity to support current and emerging technological needs of your industry	1	0	3	1	5	8	10	5	0	33
7	Enable universities to seek grants that build capacity to support current and emerging business problem-solving and benchmarking needs of your industry	0	1	0	1	4	5	7	12	3	33
8	Attract and retain skilled and trained employees to the industry	16	4	3	2	1	1	3	3	0	33
9	Facilitate collaboration between faculty across OUS schools and WSU-V	0	0	0	0	1	2	3	6	21	33
	Total	33	33	33	33	33	33	33	33	33	-

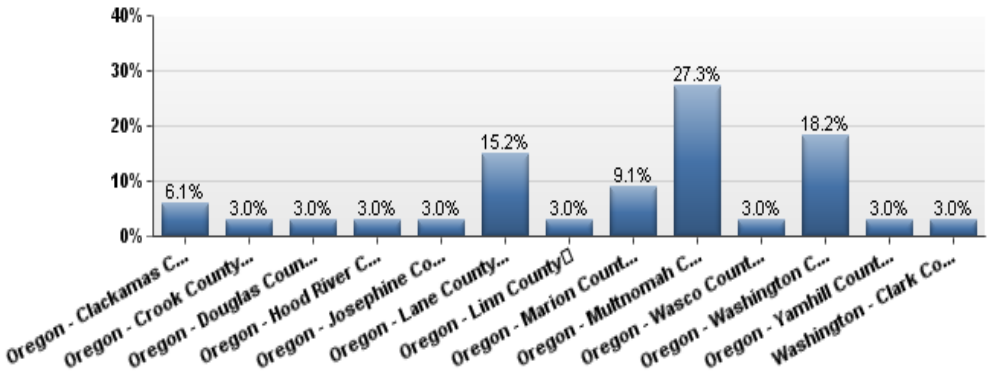
21. How large is your company in terms of total revenue?



#	Answer		Response	%
1	Less Than $500,000		7	21%
2	$500,000-1 Million		3	9%
3	$1-2.5 Million		10	30%
4	$2.5-5 Million		3	9%
5	$5-10 Million		3	9%
6	$10-20 Million		2	6%
7	$20-50 Million		1	3%
8	$50-100 Million		1	3%
9	$100-500 Million		1	3%
10	$500m - $1 Billion		0	0%
11	Prefer Not to Answer		2	6%
	Total		33	100%

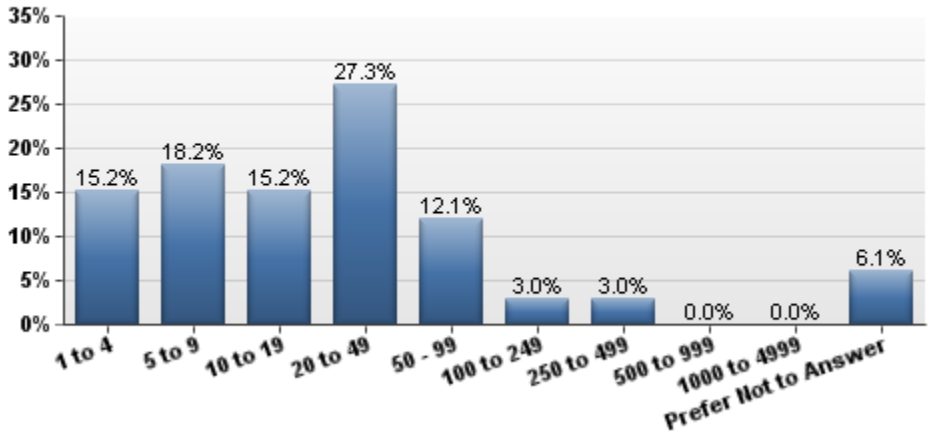
Statistic	Value
Min Value	1
Max Value	11
Mean	3.88
Variance	7.61
Standard Deviation	2.76
Total Responses	33

22. In which county are you located? Select the county from the drop down list.



#	Answer		Response	%
3	Oregon - Clackamas County		2	6%
7	Oregon - Crook County		1	3%
10	Oregon - Douglas County		1	3%
14	Oregon - Hood River County		1	3%
17	Oregon - Josephine County		1	3%
20	Oregon - Lane County		5	15%
22	Oregon - Linn County		1	3%
24	Oregon - Marion County		3	9%
26	Oregon - Multnomah County		9	27%
33	Oregon - Wasco County		1	3%
34	Oregon - Washington County		6	18%
36	Oregon - Yamhill County		1	3%
42	Washington - Clark County		1	3%
	Total		33	100%

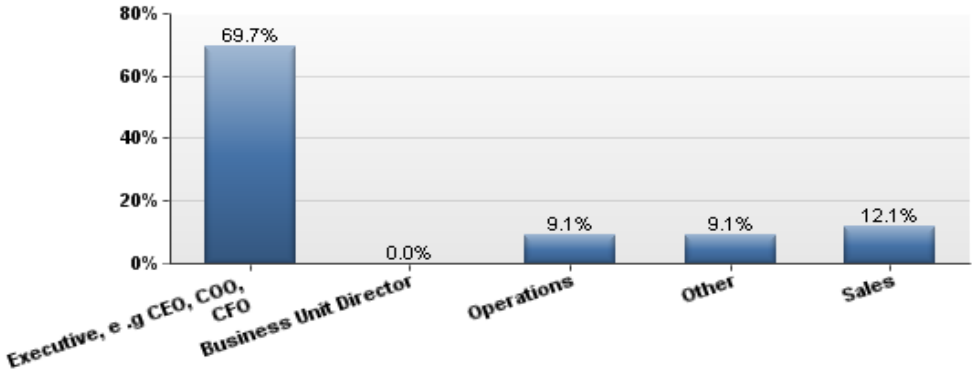
23. How large is your company in terms of total employees?



#	Answer		Response	%
1	1 to 4		5	15%
2	5 to 9		6	18%
3	10 to 19		5	15%
4	20 to 49		9	27%
5	50 - 99		4	12%
6	100 to 249		1	3%
7	250 to 499		1	3%
8	500 to 999		0	0%
9	1000 to 4999		0	0%
10	Prefer Not to Answer		2	6%
	Total		33	100%

Statistic	Value
Min Value	1
Max Value	10
Mean	3.67
Variance	4.98
Standard Deviation	2.23
Total Responses	33

24. Which of the following best describes your current position?



#	Answer		Response	%
1	Executive, e .g CEO, COO, CFO		23	70%
2	Business Unit Director		0	0%
3	Operations		3	9%
4	Sales		4	12%
5	Other		3	9%
	Total		33	100%

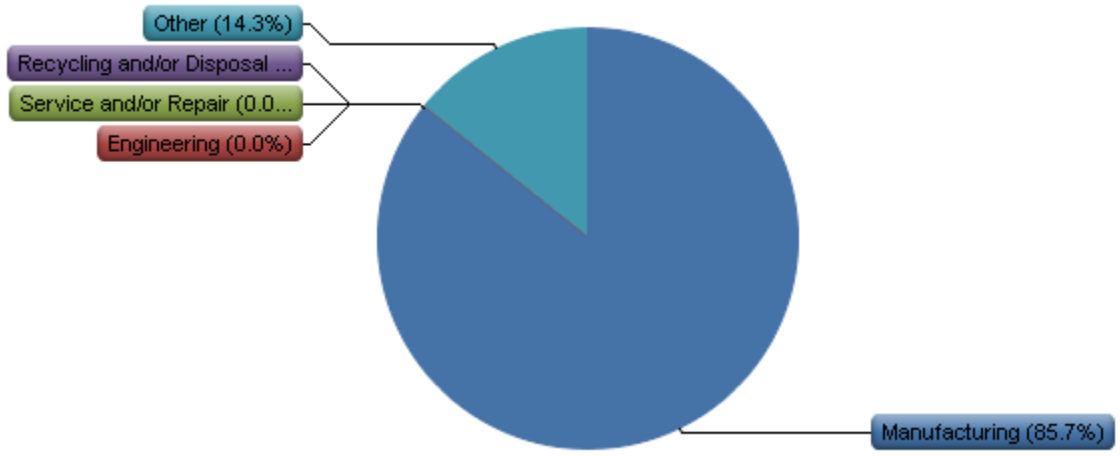
25. Thank you for your time and input. If there is anything you would like to know more about or if you have any questions, please feel free to enter your question below and put in your email address so we can get back to you.

Text Response
dan@jamtool.com
Once again the only question we have is how do we combat the 5 year subsidy that the W.T.O allowed the Chinese Government to keep businesses profitable even in rising supply chain cost. All they need do is prove to the government, is that since their original quoted price, their cost increase have made them unprofitable the Government subsidizes them to stay profitably. What can we do to manage bottom line will spending all are reserve cash in advertising and sale has brought us a big goose egg. Know we have no money and cannot promote our selves any longer without getting to some profitability we can no longer spend any money, for there is none except minimum operating capitals. don@r-dmfg.com I receive no less than 300 email a day so make it standout. Don Frey
We are having difficulty recruiting structural and mechanical E.I.T.s and drafters. Are there any services or organizations or recruiting avenues we might use to fill our needs? charlier@steelheadmetals.com

APPENDIX F: SUPPLEMENTAL ON-LINE SURVEY RESULTS FROM GROUP A AND GROUP B IN PERSON AND TELEPHONE INTERVIEWEES

NWCSM Survey Results - Group A and B (7 Responses)

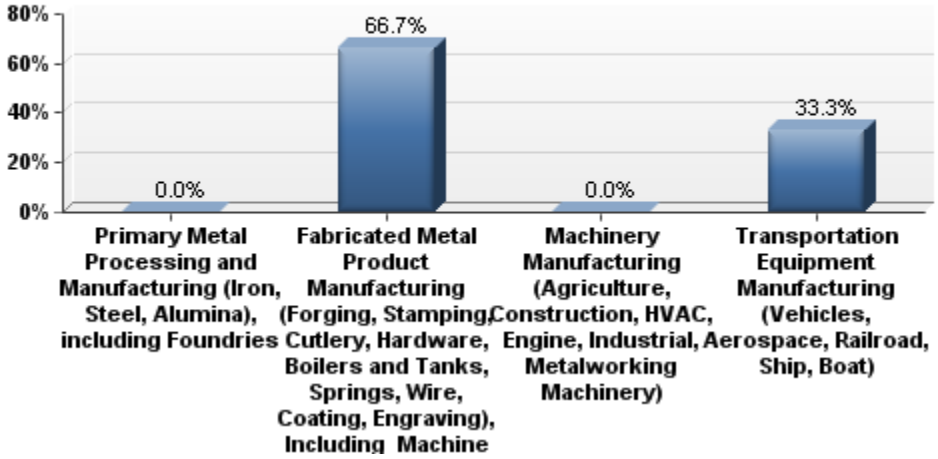
1. Which business segment best describes your company's primary business focus?



#	Answer		Response	%
1	Manufacturing		6	86%
2	Engineering		0	0%
3	Service and/or Repair		0	0%
4	Recycling and/or Disposal		0	0%
5	Other		1	14%
	Total		7	100%

Statistic	Value
Min Value	1
Max Value	5
Mean	1.57
Variance	2.29
Standard Deviation	1.51
Total Responses	7

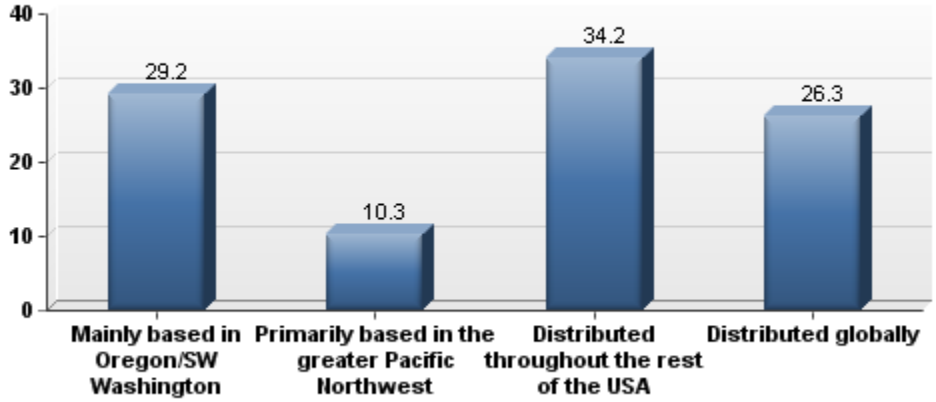
2. Which of the following sectors of the metals manufacturing industry best describes your business?



#	Answer		Response	%
1	Primary Metal Processing and Manufacturing (Iron, Steel, Alumina), including Foundries		0	0%
2	Fabricated Metal Product Manufacturing (Forging, Stamping, Cutlery, Hardware, Boilers and Tanks, Springs, Wire, Coating, Engraving), Including Machine Shops		4	67%
3	Machinery Manufacturing (Agriculture, Construction, HVAC, Engine, Industrial, Metalworking Machinery)		0	0%
4	Transportation Equipment Manufacturing (Vehicles, Aerospace, Railroad, Ship, Boat)		2	33%
	Total		6	100%

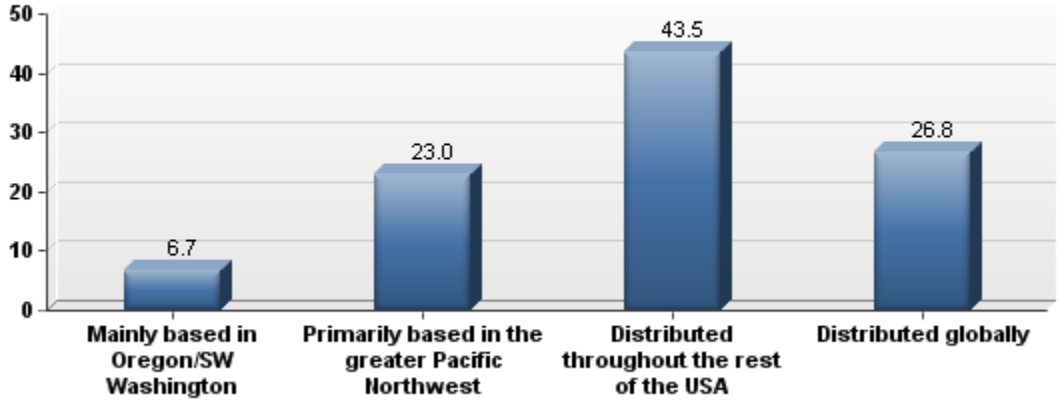
Statistic	Value
Min Value	2
Max Value	4
Mean	2.67
Variance	1.07
Standard Deviation	1.03
Total Responses	6

3. Approximately what percent of your key suppliers are located in the following areas?



#	Answer	Min Value	Max Value	Average Value	Standard Deviation
1	Mainly based in Oregon/SW Washington	5.00	90.00	29.17	31.05
2	Primarily based in the greater Pacific Northwest	0.00	20.00	10.33	8.52
3	Distributed throughout the rest of the USA	10.00	80.00	34.17	27.28
4	Distributed globally	0.00	50.00	26.33	21.37

4. Approximately what percent of your firm's customers are located in these areas?



#	Answer	Min Value	Max Value	Average Value	Standard Deviation
1	Mainly based in Oregon/SW Washington	0.00	10.00	6.67	4.08
2	Primarily based in the greater Pacific Northwest	0.00	99.00	23.00	37.86
3	Distributed throughout the rest of the USA	1.00	85.00	43.50	30.98
4	Distributed globally	0.00	60.00	26.83	27.28

5. How important are each of the issues facing your own company's competitive success over the next three years?

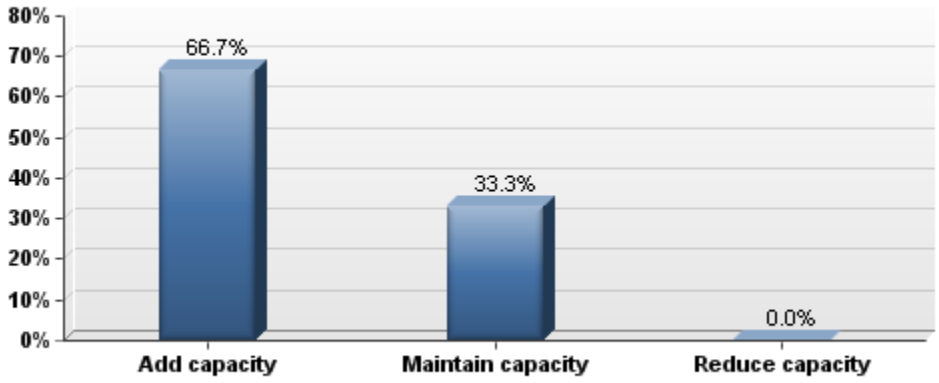
#	Question	Extremely Important	Very Important	Neither Important nor Unimportant	Very Unimportant	Not at all Important		Mean
1	Build stronger brand name and awareness	16.7%	50.0%	16.7%	0.0%	16.7%	6	2.5
2	Keep existing customers	66.7%	33.3%	0.0%	0.0%	0.0%	6	1.3
3	Attract new or a more diverse set of customers	83.3%	16.7%	0.0%	0.0%	0.0%	6	1.2
4	Enter new domestic markets	16.7%	33.3%	33.3%	16.7%	0.0%	6	2.5
5	Establish a stronger international market position	16.7%	66.7%	16.7%	0.0%	0.0%	6	2.0
6	Use new technologies to improve engineering capabilities	16.7%	50.0%	33.3%	0.0%	0.0%	6	2.2
7	Strengthen material development and research	16.7%	50.0%	16.7%	16.7%	0.0%	6	2.3
8	Develop new, differentiated or value added products	33.3%	33.3%	33.3%	0.0%	0.0%	6	2.0
9	Manage raw material costs	50.0%	50.0%	0.0%	0.0%	0.0%	6	1.5
10	Reduce risk of supply chain disruptions	16.7%	66.7%	0.0%	16.7%	0.0%	6	2.2
11	Improve efficiency in operations	50.0%	50.0%	0.0%	0.0%	0.0%	6	1.5
12	Restructure pricing	16.7%	33.3%	50.0%	0.0%	0.0%	6	2.3
13	Improve logistics/distribution options	16.7%	50.0%	33.3%	0.0%	0.0%	6	2.2

14	Improve inventory management	0.0%	50.0%	16.7%	16.7%	16.7%	6	3.0
15	Build more manufacturing capacity	0.0%	33.3%	50.0%	0.0%	16.7%	6	3.0
16	Increase training and skills of employees	33.3%	33.3%	33.3%	0.0%	0.0%	6	2.0
17	Attract and retain employees	50.0%	50.0%	0.0%	0.0%	0.0%	6	1.5
18	Improve employee productivity	33.3%	66.7%	0.0%	0.0%	0.0%	6	1.7
19	Comply with environmental laws	50.0%	50.0%	0.0%	0.0%	0.0%	6	1.5
20	Move to consolidate through mergers or acquisitions	0.0%	16.7%	50.0%	16.7%	16.7%	6	3.3

#	Question	Extremely Important	Very Important	Neither Important nor Unimportant	Very Unimportant	Not at all Important		Mean
1	Build stronger brand name and awareness	1	3	1	0	1	6	2.50
2	Keep existing customers	4	2	0	0	0	6	1.33
3	Attract new or a more diverse set of customers	5	1	0	0	0	6	1.17
4	Enter new domestic markets	1	2	2	1	0	6	2.50
5	Establish a stronger international market position	1	4	1	0	0	6	2.00
6	Use new technologies to improve engineering capabilities	1	3	2	0	0	6	2.17

7	Strengthen material development and research	1	3	1	1	0	6	2.33
8	Develop new, differentiated or value added products	2	2	2	0	0	6	2.00
9	Manage raw material costs	3	3	0	0	0	6	1.50
10	Reduce risk of supply chain disruptions	1	4	0	1	0	6	2.17
11	Improve efficiency in operations	3	3	0	0	0	6	1.50
12	Restructure pricing	1	2	3	0	0	6	2.33
13	Improve logistics/distribution options	1	3	2	0	0	6	2.17
14	Improve inventory management	0	3	1	1	1	6	3.00
15	Build more manufacturing capacity	0	2	3	0	1	6	3.00
16	Increase training and skills of employees	2	2	2	0	0	6	2.00
17	Attract and retain employees	3	3	0	0	0	6	1.50
18	Improve employee productivity	2	4	0	0	0	6	1.67
19	Comply with environmental laws	3	3	0	0	0	6	1.50
20	Move to consolidate through mergers or acquisitions	0	1	3	1	1	6	3.33

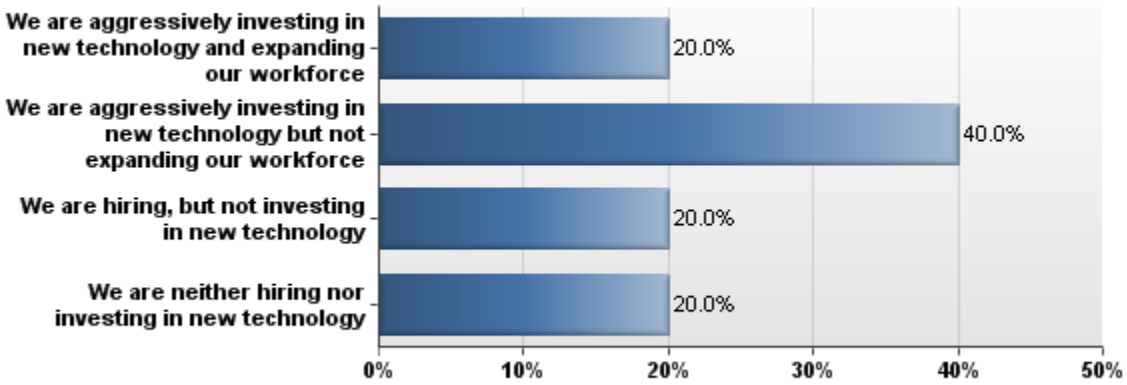
6. Which best describes how you expect to manage the capacity (equipment, technology, employees) of your business during 2013?



#	Answer		Response	%
1	Add capacity		4	67%
2	Maintain capacity		2	33%
3	Reduce capacity		0	0%
	Total		6	100%

Statistic	Value
Min Value	1
Max Value	2
Mean	1.33
Variance	0.27
Standard Deviation	0.52
Total Responses	6

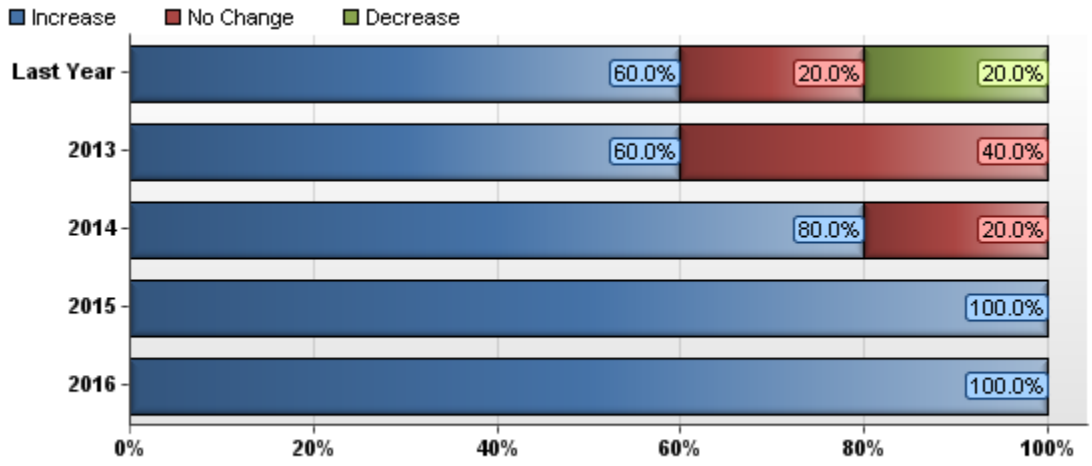
7. Which statement best describes your company's hiring and investment plans for 2013?



#	Answer		Response	%
1	We are aggressively investing in new technology and expanding our workforce		1	20%
2	We are aggressively investing in new technology but not expanding our workforce		2	40%
3	We are hiring, but not investing in new technology		1	20%
4	We are neither hiring nor investing in new technology		1	20%
	Total		5	100%

Statistic	Value
Min Value	1
Max Value	4
Mean	2.40
Variance	1.30
Standard Deviation	1.14
Total Responses	5

8. How did your company's revenue change over the last year and how do you expect it will change in 2013 and the next three years?



#	Question	Increase	No Change	Decrease		Mean
1	Last Year	60.0%	20.0%	20.0%	5	1.6
2	2013	60.0%	40.0%	0.0%	5	1.4
3	2014	80.0%	20.0%	0.0%	5	1.2
4	2015	100.0%	0.0%	0.0%	5	1.0
5	2016	100.0%	0.0%	0.0%	5	1.0

#	Question	Increase	No Change	Decrease		Mean
1	Last Year	3	1	1	5	1.60
2	2013	3	2	0	5	1.40
3	2014	4	1	0	5	1.20
4	2015	5	0	0	5	1.00
5	2016	5	0	0	5	1.00

9. How important are the following benefits of maintaining a location in Oregon/SW Washington in keeping your organization competitive?

#	Question	Extremely Important	Very Important	Neither Important nor Unimportant	Very Unimportant	Not at all Important		Mean
7	Regional infrastructure (transportation, utilities, etc.)	60.0%	20.0%	0.0%	20.0%	0.0%	5	1.8
10	Regional business costs (rent, labor, etc.)	40.0%	20.0%	40.0%	0.0%	0.0%	5	2.0
1	Hiring and retaining labor	40.0%	40.0%	20.0%	0.0%	0.0%	5	1.8
3	Supplier relationships	20.0%	40.0%	20.0%	20.0%	0.0%	5	2.4
11	Regional quality of life	20.0%	80.0%	0.0%	0.0%	0.0%	5	1.8
12	Network of other firms in your business	20.0%	40.0%	20.0%	0.0%	20.0%	5	2.6
9	Regional cost of living	20.0%	40.0%	40.0%	0.0%	0.0%	5	2.2
8	Regional business taxes	20.0%	60.0%	0.0%	20.0%	0.0%	5	2.2
5	Quality of community colleges	20.0%	40.0%	20.0%	0.0%	20.0%	5	2.6
4	Access to technical assistance	20.0%	40.0%	20.0%	20.0%	0.0%	5	2.4
6	Quality of universities	20.0%	20.0%	40.0%	20.0%	0.0%	5	2.6
2	Customer relationships	20.0%	40.0%	20.0%	20.0%	0.0%	5	2.4
13	Access to professional associations	0.0%	20.0%	60.0%	0.0%	20.0%	5	3.2

#	Question	Extremely Important	Very Important	Neither Important nor Unimportant	Very Unimportant	Not at all Important		Mean
1	Hiring and retaining labor	2	2	1	0	0	5	1.80
2	Customer relationships	1	2	1	1	0	5	2.40
3	Supplier relationships	1	2	1	1	0	5	2.40
4	Access to technical assistance	1	2	1	1	0	5	2.40
5	Quality of community colleges	1	2	1	0	1	5	2.60
6	Quality of universities	1	1	2	1	0	5	2.60
7	Regional infrastructure (transportation, utilities, etc.)	3	1	0	1	0	5	1.80
8	Regional business taxes	1	3	0	1	0	5	2.20
9	Regional cost of living	1	2	2	0	0	5	2.20
10	Regional business costs (rent, labor, etc.)	2	1	2	0	0	5	2.00
11	Regional quality of life	1	4	0	0	0	5	1.80
12	Network of other firms in your business	1	2	1	0	1	5	2.60
13	Access to professional associations	0	1	3	0	1	5	3.20

10. Are you a member of any industry networks and professional associations?

#	Answer		Response	%
1	Yes		5	100%
2	No		0	0%
	Total		5	100%

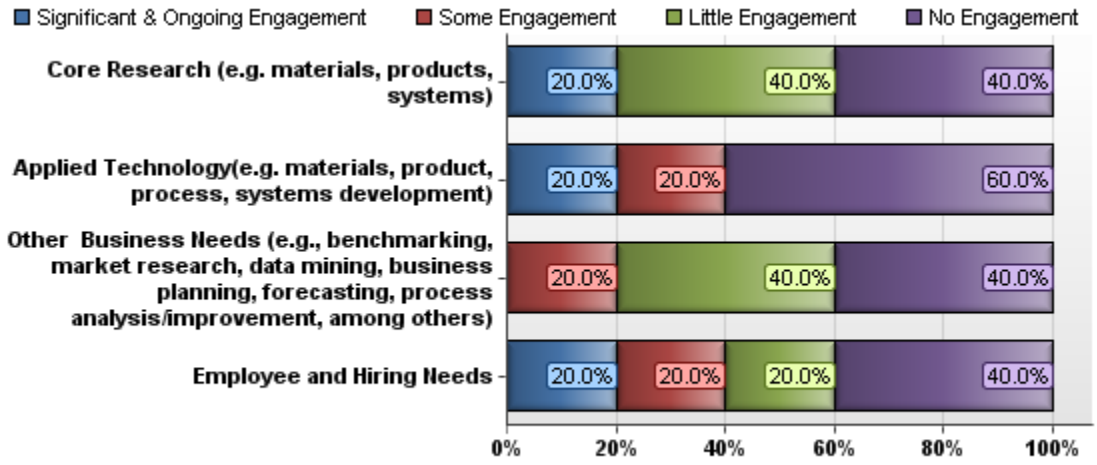
Statistic	Value
Min Value	1
Max Value	1
Mean	1.00
Variance	0.00
Standard Deviation	0.00
Total Responses	5

11. What are the most important industry networks or professional associations for your firm?

Text Response
American Institute of Steel Constructors, American Society of Mechanical Engineers, American Welding Society, American Society of Testing and Materials.
NOMMA, PNSFA, NINA
ASM, ASME, IEEE, SME, others
American Welding Society NAM
AOI Manufacturing 21 Coalition

Statistic	Value
Total Responses	5

12. What is your current level of your engagement with Universities (i.e., Engineering/Science/Business Schools at OSU, PSU, OIT, UO, or WSU-Vancouver) for supporting any of the following needs?



#	Question	Significant & Ongoing Engagement	Some Engagement	Little Engagement	No Engagement		Mean
4	Employee and Hiring Needs	20.0%	20.0%	20.0%	40.0%	5	2.8
2	Applied Technology(e.g. materials, product, process, systems development)	20.0%	20.0%	0.0%	60.0%	5	3.0
1	Core Research (e.g. materials, products, systems)	20.0%	0.0%	40.0%	40.0%	5	3.0
3	Other Business Needs (e.g., benchmarking, market research, data mining, business planning, forecasting, process analysis/improvement, among others)	0.0%	20.0%	40.0%	40.0%	5	3.2

#	Question	Significant & Ongoing Engagement	Some Engagement	Little Engagement	No Engagement		Mean
1	Core Research (e.g. materials, products, systems)	1	0	2	2	5	3.00
2	Applied Technology(e.g. materials, product, process, systems development)	1	1	0	3	5	3.00
3	Other Business Needs (e.g., benchmarking, market research, data mining, business planning, forecasting, process analysis/improvement, among others)	0	1	2	2	5	3.20
4	Employee and Hiring Needs	1	1	1	2	5	2.80

13. In the last year have you contacted your local university or community college to inquire about business assistance?

#	Answer		Response	%
1	Yes		3	60%
2	No		2	40%
	Total		5	100%

Statistic	Value
Min Value	1
Max Value	2
Mean	1.40
Variance	0.30
Standard Deviation	0.55
Total Responses	5

14. What prompted you to call?

Text Response
Looked into grant put on by PDX and PDC and local universities for developing market/manufacturing improvements utilizing university resources.
Research interests in material properties and mechanical design
Technology changes in marketplace.

Statistic	Value
Total Responses	3

15. Did you get the assistance you were looking for?

Text Response
No our grant request was denied.
yes, also through OMI
Not really

Statistic	Value
Total Responses	3

16. Looking forward, how likely would you be to use a regional linkage to a university or community college for the following business issues?

#	Question	Very Likely	Likely	Undecided	Unlikely	Very Unlikely		Mean
6	Waste reduction and closed loop process design	20.0%	20.0%	20.0%	40.0%	0.0%	5	2.8
15	Career services - professional hires	20.0%	60.0%	0.0%	20.0%	0.0%	5	2.2
16	Career services - technical hires	20.0%	60.0%	0.0%	20.0%	0.0%	5	2.2
12	Market research on customers and market segments	0.0%	20.0%	20.0%	40.0%	20.0%	5	3.6
11	Operations analysis	0.0%	40.0%	0.0%	60.0%	0.0%	5	3.2
14	Staff training	0.0%	60.0%	20.0%	20.0%	0.0%	5	2.6
10	Inventory management strategies	0.0%	0.0%	20.0%	60.0%	20.0%	5	4.0
13	Communications/advertising	0.0%	20.0%	0.0%	40.0%	40.0%	5	4.0
8	Business planning	0.0%	20.0%	0.0%	80.0%	0.0%	5	3.6
3	Mechanical engineering	0.0%	20.0%	60.0%	20.0%	0.0%	5	3.0
2	Materials science and testing	0.0%	80.0%	20.0%	0.0%	0.0%	5	2.2
4	Product design	0.0%	40.0%	0.0%	60.0%	0.0%	5	3.2
5	Lean manufacturing process	0.0%	40.0%	0.0%	60.0%	0.0%	5	3.2
1	Product development	0.0%	40.0%	40.0%	20.0%	0.0%	5	2.8
7	Environmental Risk Analysis	0.0%	40.0%	20.0%	40.0%	0.0%	5	3.0
9	Financial modeling	0.0%	20.0%	0.0%	60.0%	20.0%	5	3.8

#	Question	Very Likely	Likely	Undecided	Unlikely	Very Unlikely		Mean
1	Product development	0	2	2	1	0	5	2.80
2	Materials science and testing	0	4	1	0	0	5	2.20
3	Mechanical engineering	0	1	3	1	0	5	3.00
4	Product design	0	2	0	3	0	5	3.20
5	Lean manufacturing process	0	2	0	3	0	5	3.20
6	Waste reduction and closed loop process design	1	1	1	2	0	5	2.80
7	Environmental Risk Analysis	0	2	1	2	0	5	3.00
8	Business planning	0	1	0	4	0	5	3.60

9	Financial modeling	0	1	0	3	1	5	3.80
10	Inventory management strategies	0	0	1	3	1	5	4.00
11	Operations analysis	0	2	0	3	0	5	3.20
12	Market research on customers and market segments	0	1	1	2	1	5	3.60
13	Communications/advertising	0	1	0	2	2	5	4.00
14	Staff training	0	3	1	1	0	5	2.60
15	Career services - professional hires	1	3	0	1	0	5	2.20
16	Career services - technical hires	1	3	0	1	0	5	2.20

17. If a Collaboratory was set up in the region focused on metals manufacturing firms, how important would each of the following be in your company's decision to participate?

#	Question	Extremely Important	Very Important	Neither Important nor Unimportant	Very Unimportant	Not at all Important		Mean
12	Support to accelerate product or technology that may have a commercialization value	40.0%	0.0%	40.0%	20.0%	0.0%	5	2.4
10	Ability to develop tailored education for your employees	40.0%	40.0%	20.0%	0.0%	0.0%	5	1.8
16	Conferences and events	20.0%	20.0%	40.0%	20.0%	0.0%	5	2.6
15	Access to students and faculty to do projects on business issues	20.0%	60.0%	20.0%	0.0%	0.0%	5	2.0
17	Webinars	20.0%	20.0%	40.0%	0.0%	20.0%	5	2.8
18	Discounts to events	20.0%	0.0%	40.0%	0.0%	40.0%	5	3.4
20	A virtual environment with access to resources on a real-time basis	20.0%	20.0%	40.0%	0.0%	20.0%	5	2.8
13	Ability to participate in industry research or projects	20.0%	20.0%	60.0%	0.0%	0.0%	5	2.4
11	Participation in pre-competitive research on materials, engineering and technology	20.0%	40.0%	20.0%	20.0%	0.0%	5	2.4
6	Annual membership payment with a single fee for all firms	20.0%	0.0%	80.0%	0.0%	0.0%	5	2.6

5	Single point of contact to match your needs to resources	20.0%	60.0%	20.0%	0.0%	0.0%	5	2.0
9	Online and distance learning options for employees	20.0%	60.0%	20.0%	0.0%	0.0%	5	2.0
8	Access to career services for future employees or interns	20.0%	60.0%	20.0%	0.0%	0.0%	5	2.0
19	A physical office and designated facility	0.0%	20.0%	40.0%	0.0%	40.0%	5	3.6
4	"Member" only web portal for resources	0.0%	20.0%	60.0%	0.0%	20.0%	5	3.2
3	An easy to use website	0.0%	20.0%	40.0%	20.0%	20.0%	5	3.4
2	"Members" that include industry associations and professional networks	0.0%	60.0%	20.0%	20.0%	0.0%	5	2.6
1	"Members" that include competitors and suppliers	0.0%	40.0%	40.0%	20.0%	0.0%	5	2.8
7	Annual membership payment with tiered payment levels	0.0%	20.0%	80.0%	0.0%	0.0%	5	2.8
14	Shared-user facilities with state of the art engineering, technology and operations capabilities	0.0%	40.0%	40.0%	0.0%	20.0%	5	3.0

#	Question	Extremely Important	Very Important	Neither Important nor Unimportant	Very Unimportant	Not at all Important		Mean

1	"Members" that include competitors and suppliers	0	2	2	1	0	5	2.80
2	"Members" that include industry associations and professional networks	0	3	1	1	0	5	2.60
3	An easy to use website	0	1	2	1	1	5	3.40
4	"Member" only web portal for resources	0	1	3	0	1	5	3.20
5	Single point of contact to match your needs to resources	1	3	1	0	0	5	2.00
6	Annual membership payment with a single fee for all firms	1	0	4	0	0	5	2.60
7	Annual membership payment with tiered payment levels	0	1	4	0	0	5	2.80
8	Access to career services for future employees or interns	1	3	1	0	0	5	2.00
9	Online and distance learning options for employees	1	3	1	0	0	5	2.00
10	Ability to develop tailored education for your employees	2	2	1	0	0	5	1.80
11	Participation in pre-competitive research on materials, engineering and technology	1	2	1	1	0	5	2.40

12	Support to accelerate product or technology that may have a commercialization value	2	0	2	1	0	5	2.40
13	Ability to participate in industry research or projects	1	1	3	0	0	5	2.40
14	Shared-user facilities with state of the art engineering, technology and operations capabilities	0	2	2	0	1	5	3.00
15	Access to students and faculty to do projects on business issues	1	3	1	0	0	5	2.00
16	Conferences and events	1	1	2	1	0	5	2.60
17	Webinars	1	1	2	0	1	5	2.80
18	Discounts to events	1	0	2	0	2	5	3.40
19	A physical office and designated facility	0	1	2	0	2	5	3.60
20	A virtual environment with access to resources on a real-time basis	1	1	2	0	1	5	2.80

18. A collaboratory such as the NWSCM could be set up to achieve a number of different benefits. How would you rank the following benefits from this kind of an organization? Click and drag the ideas up/down to rank them.

#	Answer	1	2	3	4	5	6	7	8	9	

3	Build economic development in the industry across the region	60.0%	0.0%	0.0%	0.0%	20.0%	0.0%	0.0%	20.0%	0.0%	5
1	Provide research resources to help your company's R&D initiatives	40.0%	0.0%	20.0%	0.0%	0.0%	40.0%	0.0%	0.0%	0.0%	5
8	Attract and retain skilled and trained employees to the industry	0.0%	40.0%	40.0%	20.0%	0.0%	0.0%	0.0%	0.0%	0.0%	5
7	Enable universities to seek grants that build capacity to support current and emerging business problem-solving and benchmarking needs of your industry	0.0%	20.0%	20.0%	0.0%	20.0%	0.0%	0.0%	40.0%	0.0%	5
9	Facilitate collaboration between faculty across OUS schools and WSU-V	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	40.0%	0.0%	60.0%	5
5	Build connections between companies in the industry that can be developed into sales and marketing opportunities	0.0%	0.0%	0.0%	40.0%	0.0%	20.0%	0.0%	20.0%	20.0%	5

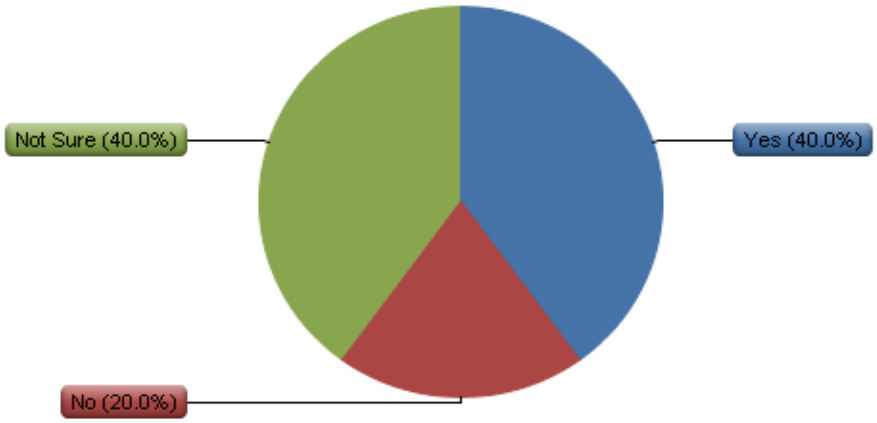
2	Support your company seek as it seeks grants from government agencies	0.0%	20.0%	20.0%	0.0%	0.0%	0.0%	20.0%	20.0%	20.0%	5
4	Support advocacy and public policy discussions at the state, regional and local levels	0.0%	20.0%	0.0%	0.0%	40.0%	40.0%	0.0%	0.0%	0.0%	5
6	Enable universities to seek grants that build capacity to support current and emerging technological needs of your industry	0.0%	0.0%	0.0%	40.0%	20.0%	0.0%	40.0%	0.0%	0.0%	5
	Total	5	5	5	5	5	5	5	5	5	-

#	Answer	1	2	3	4	5	6	7	8	9	
1	Provide research resources to help your company's R&D initiatives	2	0	1	0	0	2	0	0	0	5
2	Support your company seek as it seeks grants from government agencies	0	1	1	0	0	0	1	1	1	5
3	Build economic development in the industry across the region	3	0	0	0	1	0	0	1	0	5

4	Support advocacy and public policy discussions at the state, regional and local levels	0	1	0	0	2	2	0	0	0	5
5	Build connections between companies in the industry that can be developed into sales and marketing opportunities	0	0	0	2	0	1	0	1	1	5
6	Enable universities to seek grants that build capacity to support current and emerging technological needs of your industry	0	0	0	2	1	0	2	0	0	5
7	Enable universities to seek grants that build capacity to support current and emerging business problem-solving and benchmarking needs of your industry	0	1	1	0	1	0	0	2	0	5
8	Attract and retain skilled and trained employees to the industry	0	2	2	1	0	0	0	0	0	5

9	Facilitate collaboration between faculty across OUS schools and WSU-V	0	0	0	0	0	0	2	0	3	5
	Total	5	5	5	5	5	5	5	5	5	-

19. Overall does the concept of the NWCSM appeal to you to support your technological or business needs?



#	Answer		Response	%
1	Yes		2	40%
2	No		1	20%
3	Not Sure		2	40%
	Total		5	100%

Statistic	Value
Min Value	1
Max Value	3
Mean	2.00
Variance	1.00
Standard Deviation	1.00
Total Responses	5

20. What information would you need to know more about to make this concept more appealing?

Text Response
We need to compare what each of the current organizations are doing and offering, What are we paying for and why. Do we all fit in one group and will this be isolated to metals only. (I believe that keeping this metals only is critical)
Who's in control of it and how long would it take to get something started. MFG21 has been at it for a long time and I haven't seen much develop from it yet.
costs and deliverables

Statistic	Value
Total Responses	3

21. How large is your company in terms of total revenue?

#	Answer		Response	%
1	Less Than $500,000		0	0%
2	$500,000-1 Million		0	0%
3	$1-2.5 Million		0	0%
4	$2.5-5 Million		1	20%
5	$5-10 Million		1	20%
6	$10-20 Million		0	0%
7	$20-50 Million		0	0%
8	$50-100 Million		1	20%
9	$100-500 Million		0	0%
10	$500m - $1 Billion		2	40%
11	Prefer Not to Answer		0	0%
	Total		5	100%

Statistic	Value
Min Value	4
Max Value	10
Mean	7.40
Variance	7.80
Standard Deviation	2.79
Total Responses	5

22. In which county are you located? Select the county from the drop down list.

#	Answer		Response	%
1	Oregon - Baker County		0	0%
2	Oregon - Benton County		0	0%
3	Oregon - Clackamas County		3	60%
4	Oregon - Clatsop County		0	0%
5	Oregon - Columbia County		0	0%
6	Oregon - Coos County		0	0%
7	Oregon - Crook County		0	0%
8	Oregon - Curry County		0	0%
9	Oregon - Deschutes County		0	0%
10	Oregon - Douglas County		0	0%
11	Oregon - Gilliam County		0	0%
12	Oregon - Grant County		0	0%
13	Oregon - Harney County		0	0%
14	Oregon - Hood River County		0	0%
15	Oregon - Jackson County		0	0%
16	Oregon - Jefferson County		0	0%
17	Oregon - Josephine County		0	0%
18	Oregon - Klamath County		0	0%
19	Oregon - Lake County		0	0%
20	Oregon - Lane County		0	0%
21	Oregon - Lincoln County		0	0%
22	Oregon - Linn County		0	0%
23	Oregon - Malheur County		0	0%
24	Oregon - Marion County		0	0%
25	Oregon - Morrow County		0	0%
26	Oregon - Multnomah County		2	40%
27	Oregon - Polk County		0	0%
28	Oregon - Sherman County		0	0%
29	Oregon - Tillamook County		0	0%
30	Oregon - Umatilla County		0	0%
31	Oregon - Union County		0	0%
32	Oregon - Wallowa County		0	0%
33	Oregon - Wasco County		0	0%
34	Oregon - Washington County		0	0%
35	Oregon - Wheeler County		0	0%
36	Oregon - Yamhill County		0	0%

37	Washington - Adams County		0	0%
38	Washington - Asotin County		0	0%
39	Washington - Benton County		0	0%
40	Washington - Chelan County		0	0%
41	Washington - Clallam County		0	0%
42	Washington - Clark County		0	0%
43	Washington - Columbia County		0	0%
44	Washington - Cowlitz County		0	0%
45	Washington - Douglas County		0	0%
46	Washington - Ferry County		0	0%
47	Washington - Franklin County		0	0%
48	Washington - Garfield County		0	0%
49	Washington - Grant County		0	0%
50	Washington - Grays Harbor County		0	0%
51	Washington - Island County		0	0%
52	Washington - Jefferson County		0	0%
53	Washington - King County		0	0%
54	Washington - Kitsap County		0	0%
55	Washington - Kittitas County		0	0%
56	Washington - Klickitat County		0	0%
57	Washington - Lewis County		0	0%
58	Washington - Lincoln County		0	0%
59	Washington - Mason County		0	0%
60	Washington - Okanogan County		0	0%
61	Washington - Pacific County		0	0%
62	Washington - Pend Oreille County		0	0%
63	Washington - Pierce County		0	0%
64	Washington - San Juan County		0	0%
65	Washington - Skagit County		0	0%
66	Washington - Skamania County		0	0%
67	Washington - Snohomish County		0	0%
68	Washington - Spokane County		0	0%
69	Washington - Stevens County		0	0%
70	Washington - Thurston County		0	0%
71	Washington - Wahkiakum County		0	0%
72	Washington - Walla Walla County		0	0%
73	Washington - Whatcom County		0	0%
74	Washington - Whitman County		0	0%

75	Washington - Yakima County		0	0%
	Total		5	100%

23. How large is your company in terms of total employees?

#	Answer		Response	%
1	1 to 4		0	0%
2	5 to 9		0	0%
3	10 to 19		1	20%
4	20 to 49		1	20%
5	50 - 99		0	0%
6	100 to 249		0	0%
7	250 to 499		1	20%
8	500 to 999		0	0%
9	1000 to 4999		2	40%
10	Prefer Not to Answer		0	0%
	Total		5	100%

Statistic	Value
Min Value	3
Max Value	9
Mean	6.40
Variance	7.80
Standard Deviation	2.79
Total Responses	5

24. Which of the following best describes your current position?

#	Answer		Response	%
1	Executive, e .g CEO, COO, CFO		3	60%
2	Business Unit Director		2	40%
3	Operations		0	0%
4	Sales		0	0%
5	Other		0	0%
	Total		5	100%

25. Thank you for your time and input. If there is anything you would like to know more about or if you have any questions, please feel free to enter your question below and put in your email address so we can get back to you.

Text Response

Statistic	Value
Total Responses	0

APPENDIX G: CONSORTIUMS EVALUATED

- A*Star/Simtech (Singapore)
- Advanced Manufacturing Research Centre (United Kingdom)
- Excellence in Manufacturing Consortium (Canada)
- JACME2T - Joint Arizona Consortium Manufacturing and Engineering Education for Tomorrow) Consortium (Arizona)
- The Solar Energy Consortium (TSEC) (New York)
- Composites Manufacturing Technology Center and The Composites Consortium (South Carolina)
- Green Manufacturing Industrial Consortium at Western Michigan University (Michigan)
- Metal Processing Institute at Worcester Polytechnic Institute (Massachusetts)
- Center for Advanced Manufacturing Puget Sound (Washington)
- EWI (Additive Manufacturing Consortium) (Ohio)
- Conexus Indiana (Indiana)
- Advanced Manufacturing Institute, Kansas State University (Kansas)
- Grand Rapids Community College Advanced Manufacturing Partnership (Michigan)
- Bay Area Photovoltaic Consortium (California)
- Commonwealth Center for Advanced Manufacturing (Virginia)
- Connecticut Center for Advanced Technology (Connecticut)
- National Center for Manufacturing Sciences (Michigan)
- South Carolina Rapid Application of New Technologies (South Carolina)
- Sirris (Belgium)
- AIMEE Instito Tecnologico Metalmecanico (Spin)
- Rapiman (Rapid Prototyping and Innovative Manufacturing Network) (Slovenia)
- Direct Manufacturing Research Center, University Paderborn (Germany)
- Inspire AG (Switzerland)
- Innovate Washington (Washington)
- WIRE-Net (Ohio)
- Michigan Automation Alley (Michigan)
- Korean Industrial Complex Corporation (Korea)
- Massachusetts Life Sciences Collaborative (Massachusetts)
- Sarasota County Economic Development Corporation (Florida)

APPENDIX H: UNIVERSITY INTERVIEWS

Used a combination of in person structured interview, structured interview over the phone, and written response to a structured survey.

Oregon Institute of Technology

- Charlie Jones, Dean of Engineering, Technology and Management
- Brian Moravec, Professor and Department Chair, Manufacturing and Mechanical Engineering and Technology
- Geoffrey Peter, Assistant Professor, Manufacturing and Mechanical Engineering and Technology
- Joe Stuart, Assistant Professor, Manufacturing Engineering Technology

Oregon State University

- Karl Haapala, Assistant Professor, Industrial and Mechanical Engineering
- Jamie Kruzic, Associate Professor, Mechanical Engineering
- Logen R. Logendran, Professor, Industrial and Manufacturing Engineering
- John Parmigiani, Research Assistant Professor of Mechanical Engineering
- Brian Paul, Thomas West Professor of Industrial and Manufacturing Engineering
- David Kim, Associate Professor, School of Mechanical, Industrial & Manufacturing Engineering

Portland State University

- Gerald "Jerry" W. Recktenwald , Associate Professor and Chair, Mechanical and Materials Engineering Department
- Renjeng Su, Dean of Maseeh College of Engineering and Computer Science
- Bill Wood, Professor, Mechanical and Materials Engineering Department
- Lemmy Meekisho, Associate Professor, Mechanical and Materials Engineering Department

University of Oregon

- Tolga Aydinliyim, Assistant Professor, Operations Management
- James Bean, Senior Vice President and Provost
- Eren Cil, Assistant Professor, Operations Management
- Kees DeKluyver, Dean, Lundquist College of Business
- Erika Foin, Executive Director, Oregon Executive MBA
- Jennifer Howard-Grenville, Associate Professor, Management

- Xing Hu, Assistant Professor, Operations Management
- John Hull, Managing Director, Business Innovation Institute, Lundquist College of Business
- Chris Larson, Material Sciences Institute, University of Oregon
- Nathan Lillegard, Program Manager, Lundquist Center for Entrepreneurship
- Rebecca Monro, Assistant Dean, Oregon MBA program
- Dale Morse, Academic Director, Oregon Executive MBA and Professor of Accounting
- Mike Pangburn, Associate Professor, Operations Management
- Anne Parmigiani, Associate Professor, Management
- Mike Russo, Professor, Management
- Anne Scott, Alumni Relations, Oregon Executive MBA
- Laura Strohm, Program Manager, Center for Sustainable Business Practices
- Ed Warnock, Oregon Executive MBA
- Zhibin Yang, Assistant Professor, Operations Management
- Rosemarie Ziedonis, Associate Professor, Management

Washington State University - Vancouver

- Bob Bates, Director of Research and Graduate Education
- Dave Kim, Associate Professor, Mechanical Engineering
- Praveen Sekhar, Assistant Professor, Electrical Engineering
- Hakan Gurocak, Director, School of Engineering and Computer Science

APPENDIX I: ASSOCIATION AND NETWORKING GROUP INTERVIEWS CONDUCTED DURING PROJECT

- Chris Scherer, Oregon Manufacturing Extension Partnership
- Julie Hatten, Northwest High Performance Enterprise Consortium
- Sean Murphy, Pacific Northwest Defense Coalition
- Bernie Bottomly, Portland Business Alliance
- Corky Collier, Columbia Corridor Association
- Nate Lia Braaten, HIDEC
- Lowell Gibson, SOHPEC
- Dave Oatman, Emerald Valley HPEC
- David Kenney, Oregon BEST

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