

## Final Technical Report

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<b>Award Number:</b>	DE-FC36-02GO 12073
<b>Project Title:</b>	Industrial Assessment Center Program
<b>Project Period:</b>	9/1/2002 to 11/30/2006
<b>Recipient Organization:</b>	Loyola Marymount University 1 LMU Drive, Los Angeles, CA 90045
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### Executive Summary

The document contains Final Technical Report on the Industrial Assessment Center Program at Loyola Marymount University in Los Angeles, covering the contract period of 9/1/2002 to 11/30/2006, under the contract DE-FC36-02GO 12073.

The Report describes six required program tasks, as follows:

TASK 1 is a summary of the assessments performed over the life of the award: 77 assessments were performed, 595 AR were recommended, covering a very broad range of manufacturing plants.

TASK 2 is a description of the efforts to promote and increase the adoption of assessment recommendations and employ innovative methods to assist in accomplishing these goals.

The LMU IAC has been very successful in accomplishing the program goals, including implemented savings of \$5,141,895 in energy, \$10,045,411 in productivity and \$30,719 in waste, for a total of \$15,218,025. This represents 44% of the recommended savings of \$34,896,392.

TASK 3 is a description of the efforts promoting the IAC Program and enhancing recruitment efforts for new clients and expanded geographic coverage. LMU IAC has been very successful recruiting new clients covering Southern California. Every year, the intended number of clients was recruited.

TASK 4 describes the educational opportunities, training, and other related activities for IAC students. A total of 38 students graduated from the program, including 2-3 graduate students every semester, and the remainder undergraduate students, mostly from the Mechanical Engineering Department. The students received formal weekly training in energy (75%) and productivity (25). All students underwent extensive safety training. All students praised the IAC experience very highly.

TASK 5 describes the coordination and integration of the Center activities with other Center and IAC Program activities, and DOE programs. LMU IAC worked closely with MIT, and SDSU IAC and SFSU IAC, and enthusiastically supported the SEN activities.

TASK 6 describes other tasks and accomplishments. During the award period, Assistant Director Rudy Marloth became a DOE Qualified Specialist in PHAST,

a DOE Qualified Specialist in Compressed Air, and a Certified Energy Manager, and earned a MS degree in Environmental Science.

**TASK 1: Conduct Industrial Assessments, to include a variety of plant types and sizes as well as coverage of the geographic area defined in the Annual Workplan Industrial Assessment.** *(Provide a summary of the assessments performed over the life of the award. Include overall number of assessments, types of businesses assessed, number of ARs, and any other related info.)*

Assessments performed: 76 ARs: 595

See tables for details.

Assessment Numbers, Types of Businesses, and Number of ARs for 2003 and 2004

2003			2004		
Report #	business	ARs	Report #	business	ARs
46	drugs	13	65	plastic film	6
47	castings	15	66	PWBs	7
48	shingles	12	67	forging	10
49	dies & jigs	8	68	castings	9
50	canned juice	14	69	tissue pads	17
51	tortilla chips	7	70	gears	11
52	containers	7	71	test equipmt	10
53	transformers	6	72	store fixtures	6
54	fasteners	8	73	bed frames	12
55	flex cable	8	74	heat treating	10
56	castings	10	75	carpet pad	7
57	color printing	5	76	egg flats	7
58	textiles	5	77	glass doors	6
59	kraft paper	9	78	salsa	12
60	mtrcycle parts	15	79	vacuum form	6
61	concrete pipe	13	80	castings	7
62	fireplaces	12	81	electroplating	7
63	tubular parts	5	82	croutons	6
64	steel pipe	13	83	plastic	6
			84	margarine	13
			85	castings	10
19 total		185 total	21 total		185 total

Assessment Numbers, Types of Businesses, and Number of ARs for 2005 and 2006

2005			2006		
Report #	business	ARs	Report #	business	ARs
86	food	5	105	shelving	5
87	metal forming	8	106	electroplating	2
88	metal forming	5	107	labels	6
89	furniture	6	108	frozen food	5
90	thread rolling	7	109	batteries	7
91	castings	7	110	battery plates	6
92	heat treating	11	111	shingles	6
93	PVC glue	5	112	seals & valves	6
94	boxes	5	113	food	3
95	insecticide	12	114	RV panels	5
96	capacitors	10	115	capacitors	11
97	plastics	7	116	cheese	6
98	auto parts	7	117	canned foods	6
99	vinyl	7	118	castings	4
100	potted plants	6	119	defnse analysis	6
101	fasteners	5	120	animal feed	6
102	aerospce parts	5	121	dyeing	4
103	dog food	8			
104	aerospace	5			
19 total		131 total	17 total		94 total

**TASK 2: Promote and increase the adoption of assessment recommendations and employ innovative methods to assist in accomplishing these goals. (Provide a summary of the efforts used to promote the adoption of ARs, including any available overall adoption statistics.)**

Both the Director and the Assistant Director attended almost every assessment, providing strengths in both energy and productivity, resulting in a high number of quality recommendations, and reflected in the implementation rate.

We delivered the report in person to several clients, with a slide presentation.

Because many clients suffered cash flow problems, we focused on inexpensive recommendations.

We performed several major rewrites of the AR and Report templates to make the reports more user friendly.

We stopped recommending ARs which had a poor implementation rate.

During the exit interview, we asked the client managers if they had an interest in implementing each idea. The ideas that elicited no interest were dropped.

We sent the reports to many client CEOs and CFOs, in addition to the contact managers, when applicable.

We sent our internal implementation form to the Client just prior to the implementation interview. This served as the basis for the implementation data collection. In order to reduce ambiguity, we redesigned the form to make it more user friendly, and to provide better and clearer explanations. Clients entered the implementation data themselves, which yielded more objective assessments than verbal interviews.

Since we observed that implementation rate depended heavily on the time elapsed between the audit and receipt of the report, we introduced payment penalties to motivate students to produce the reports more promptly.

We developed many new energy ARs. The titles were per ARC codes, but the content was custom developed.

We made a special effort (unique nationally) to link productivity to energy, with all original ARs.

We elected to send the 12-month implementation requests to all clients, as an experiment to see what kind of reply statistics might result. None of the Clients in this group reported any additional implementations.

Recommended and Implemented Dollars and Energy

Category	2003	2004	2005	2006	Total
Rec. Waste \$\$	39,916	23,873	12,000	35,020	<b>\$110,809</b>
Imp. Waste \$\$	16,200	2519	12,000	0	<b>\$30,719</b>
Rec. Prod. \$\$	13,919,733	4,979,055	4,457,515	4,459,110	<b>\$27,815,413</b>
Imp. Prod. \$\$	3,737,699	2,180,673	2,249,290	1,877,749	<b>\$10,045,411</b>
Rec. Energy MMB	56,863	68,195	246,797	572,009	<b>943,864 MMB</b>
Imp. energy MMB	27,754	28,441	208,114	491,623	<b>755,932 MMB</b>
Rec. Energy \$\$	660,369	777,312	673,126	4,859,363	<b>\$6,970,170</b>
Imp. Energy \$\$	312,365	355,380	364,893	4,109,257	<b>\$5,141,895</b>

**TASK 3: Promote the IAC Program and enhance recruitment efforts for new clients and expanded geographic coverage.** *(Describe efforts to promote the IAC program and expand the reach of the center.)*

We promoted the IAC via Southern California Edison, Southern California Gas Company, several local large aerospace corporations, our alumni network, the network of the Friends of the University, and at President's Day (our annual back-to-school day).

All Clients expressed satisfaction with our services, and many offered enthusiastic satisfaction, which helps in the program promotion by word of mouth.

We distributed the IAC brochures and the free CDs with Best Practice Tools to all Clients.

We promoted the Save Energy Now initiative.

Our Year 4 SIC codes were unique, with one repetition, and another repetition due to the two-day assessment. The zip codes indicate a broad geographical distribution in the greater Los Angeles basin.

We were successful recruiting among a diverse group of SIC codes and geographical locations.

We promoted the program at every opportunity: in professional meetings and local energy training sessions, during open houses at LMU|LA, during informal professional contacts in private meetings, and with CMT (California Manufacturing Technology Consulting).

LMU|LA IAC hosted a one-day workshop organized by the "Alliance to Save Energy" (a DoE program). Bo Oppenheim (IAC Director) gave a brief presentation about the IAC services and Rudy Marloth (Assistant Director) gave a lecture on CHP. About 30 people attended, 20% from industry and 80% from local non-manufacturing institutions.

Bo Oppenheim was a speaker at the IIEE conference for industrial engineers at USC. He described the IAC program during his talk, and promoted the program heavily when mingling and networking.

On three occasions Rudy Marloth, Assistant Director, gave talks at CMTC workshops about the IAC program. In general, LMU|LA IAC continued the informal but friendly arms-length synergistic relationship with the CMTC, a large California non-profit entity partly supported by NIST and partly by the State, devoted to productivity, Lean, and productivity impact on energy. As a result of these focused efforts, four companies signed up for assessments.

The Assistant Director addressed a group of Southern California Edison customer representatives on the workings, the long-term benefits, and virtues of the IAC program.

Our Year 3 distribution the SIC codes had only one repetition (otherwise were unique). The zip codes indicated a broad geographical distribution.

We traveled as far as Wasco (lower central valley) for a two-day assessment, to Oxnard, and to Sylmar. Our 100<sup>th</sup> assessment was at a floriculture nursery in Nipomo, a small town on the central coast. In March of 2006, we made a three-day trip to the central valley and did three assessments there, in Goshen, Visalia, and Lemoore.

**TASK 4: Provide educational opportunities, training, and other related activities for IAC students.**  
*(Summarize education, training, and any other activities for the students. Include overall number of students that participated during the course of the award.)*

The IAC students and faculty regularly met once a week for an hour-long meeting devoted to a formal training in a specific area of energy (about 75% of the meetings), and manufacturing processes and productivity (about 25%). At the beginning of each year sessions were devoted to the following subjects:

- Safety
- New reports and AR formats, and new (shorter) deadlines for Report writing
- DOE and IAC internet resources and database
- A general training session for the team on the new policies and recommendations provided during the Directors' meeting in the previous summer
- Understanding the national IAC program and the DOE goals
- Involvement of students in all aspects of the IAC Program
- Need for new students to sign into the database, and the need to perform exit interviews when graduating
- Report on the national ranking of LMU IAC
- Training for the lead student on how to guide other students through the national activities

Students received formal training handouts. The remaining time was spent on work allocation and administrative matters.

All incoming students received a safety training based on the IAC CD, plus significant anecdotal

reinforcement. A student was designated as the Safety Officer for each audit. He/she was to review safety points from a checklist while driving to the Client, and was to monitor the team's activities for safety during the audit.

The Assistant Director and various students regularly attended one-day training sessions offered by the CTAC (Customer Technology Applications Center) of the Southern California Edison.

Student participation:

2003: 18  
2004: 18  
2005: 19  
2006: 15  
**Total: 38**

Most of the students were undergraduates. In addition, every semester 2-3 graduate students participated in the program.

**TASK 5: Coordinate and integrate Center activities with other Center and IAC Program activities, DOE's Industrial Technologies programs and other EERE programs. (Summarize the integration activities with other centers, the ITP program, state programs, etc.)**

We had continuing informal contacts with several other IACs, in particular SDSU and SFSU. We continued to refer companies in Orange County to our colleagues in the SDSU IAC.

LMU|LA IAC brought to the national program a unique expertise in Productivity and Lean methods. The IAC Director was a member of the MIT-based Lean Aerospace Initiative ([www.lmu.edu/lai-en](http://www.lmu.edu/lai-en)). He spent most of his sabbatical at MIT working on Lean research. LMU|LA is the leading school in Southern California for teaching MIT-developed Lean Academies for industry.

We worked actively in trying to save the national IAC program. The LMU President and College of Science & Engineering Dean, the IAC Director and Assistant Director, several other faculty members, and almost all IAC students wrote letters to our two Senators and one Congresswoman.

Dr. Oppenheim published two papers on the productivity impact on energy, one in a journal of energy and the other in the Encyclopedia of Energy.

LMU IAC is enthusiastically participating in all SEN related activities: teleconferences, workshop preparation, promotions, change of report covers, etc. Our web page was revamped to reflect the SEN activities.

**TASK 6: Other tasks or special projects, as needed, and as determined by DOE to be advantageous to the program and in furtherance of IAC Program goals. (Briefly describe any other special projects or tasks performed for DOE under the award.)**

We changed our already excellent pay scale to motivate students to complete the Reports even faster than previously.

During the award period, Assistant Director Rudy Marloth became a DOE Qualified Specialist in PHAST, a DOE Qualified Specialist in Compressed Air, and a Certified Energy Manager.

LMU IAC presented a case study for Client # 85 at the 2005 Directors' Meeting. The Client implemented almost all ARs fully and realized significant savings. The company became very profitable directly as a result of LMU IAC recommendations.

We contacted all seven SEN plants assigned to us. Two were not interested. Five became clients.