WHAT ARE THE CDIO MEMBER UNIVERSITIES EMPHASIZING IN ENGINEERING EDUCATION?

(PRELIMINARY) FINDINGS FROM THE CDIO SURVEY

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INTRODUCTION

- The CDIO approach to engineering education was introduced in the early 2000's.
- Some universities have gained considerable long-term experience in applying the approach, and thus it seems timely to summarize and evaluate those experiences.
- The CDIO status survey was sent to about 120 universities
- The aims of the survey were to:
  - Map out where and in what programmes/disciplines CDIO is currently applied
  - Evaluate the effects on outcomes, the perceived benefits, the limitations, any barriers to implementation,
  - Identify development needs of the CDIO approach and the CDIO community

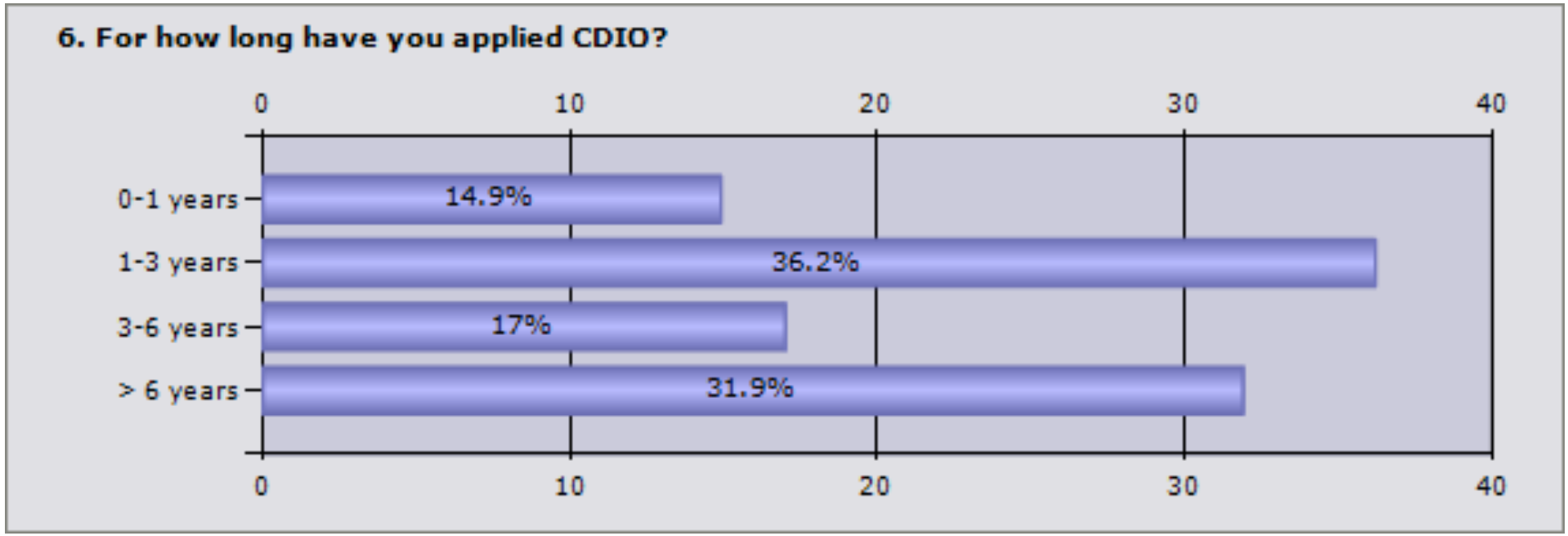
SURVEY DESIGN

The survey was comprised of approximately 50 questions in the following categories:

- University categorization and CDIO use
- State of university's CDIO implementation
- Statements on effects on input, resource and output metrics
- Barriers and success factors
- Open-ended questions

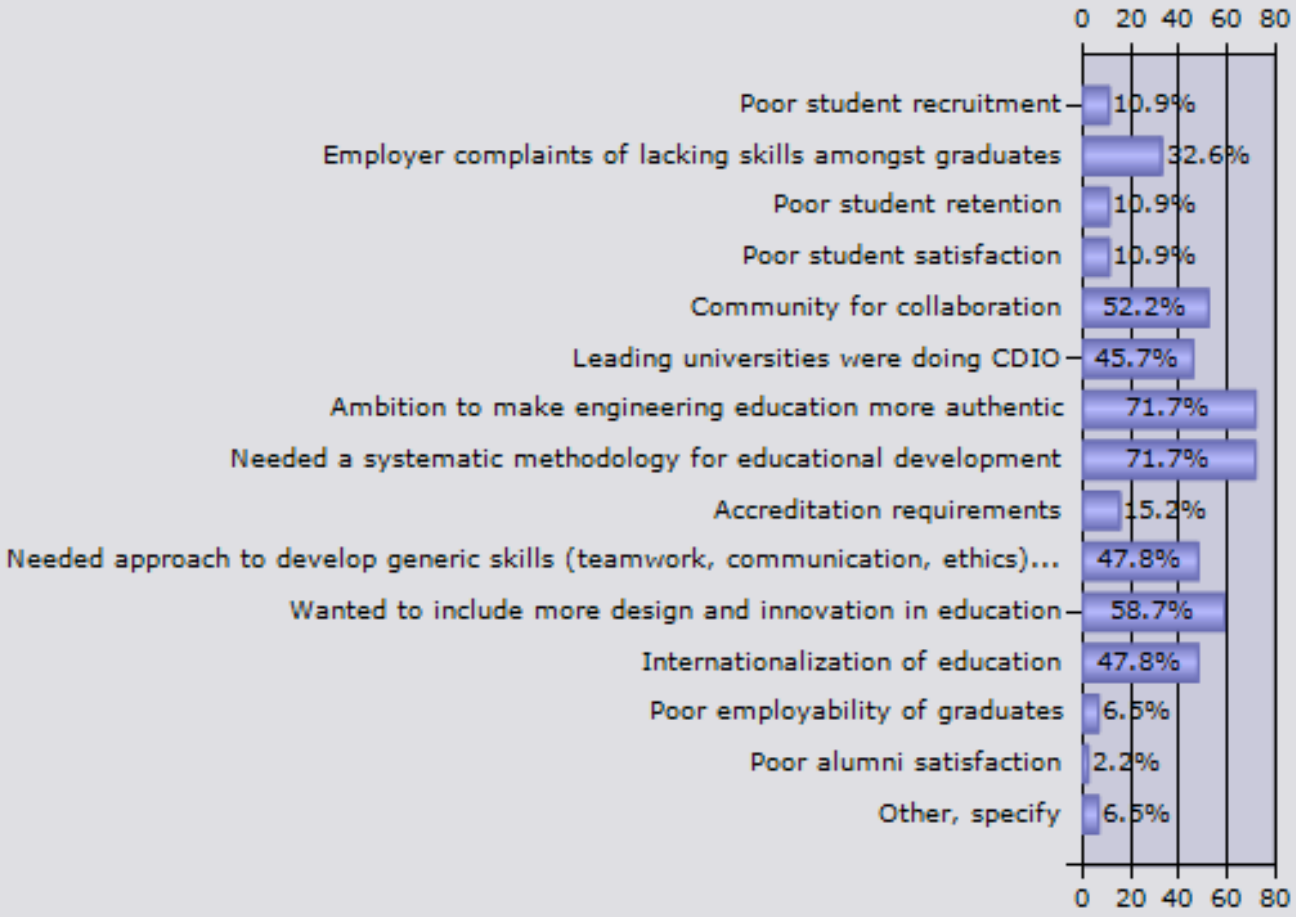
RESPONSES

- 47 responses
- 22 countries
- 6 regions
- 4.2 average years of CDIO application

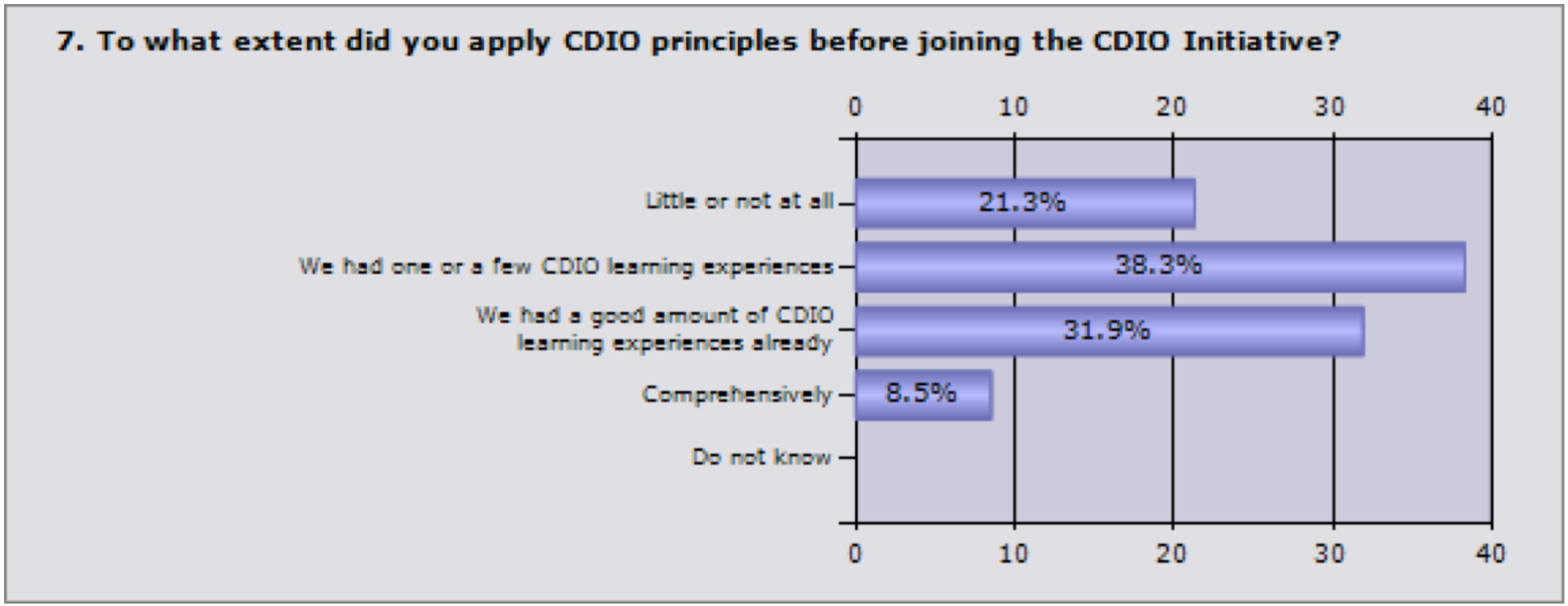


MOTIVES FOR ADOPTING CDIO

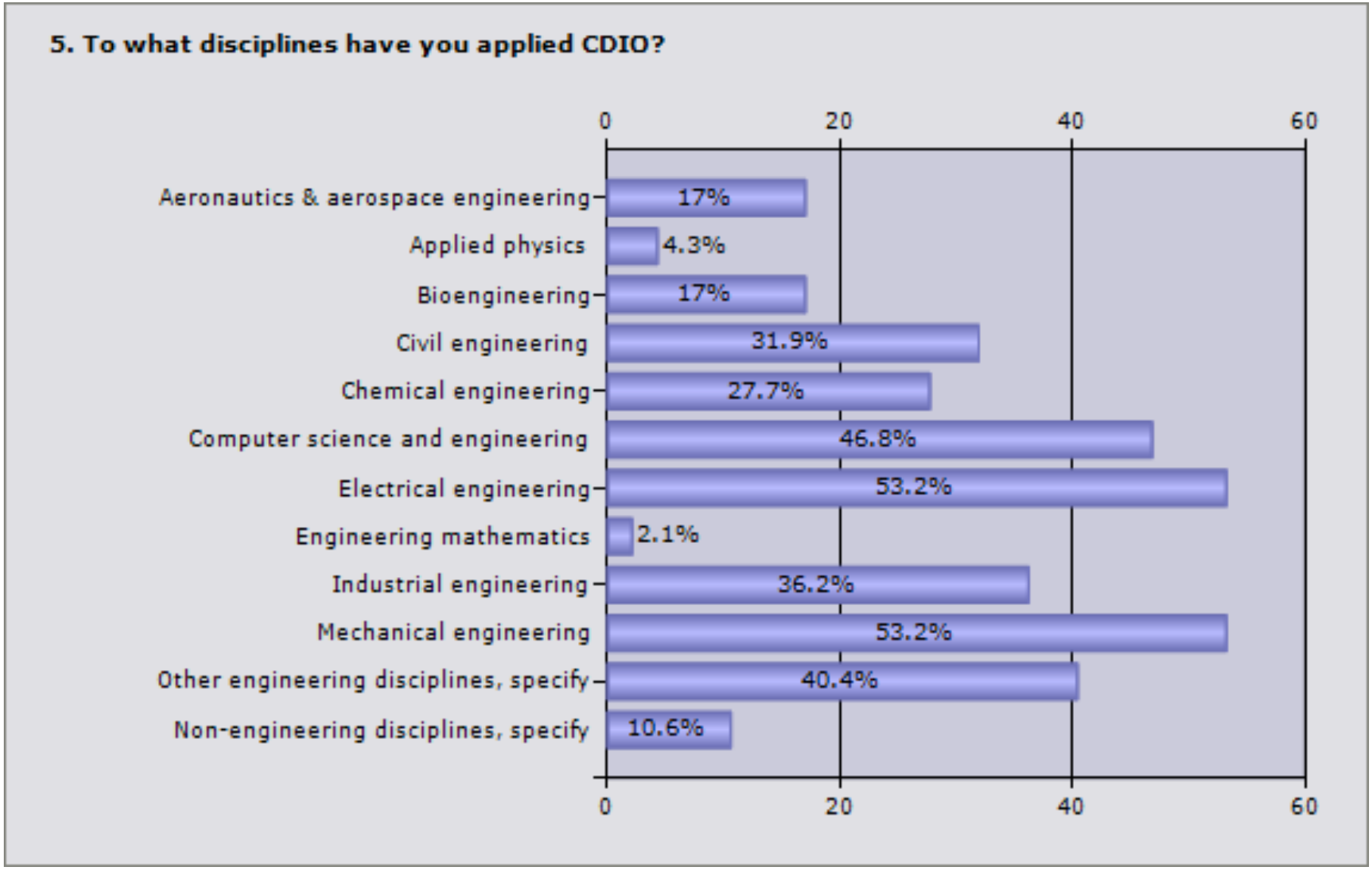
10. What educational challenges or opportunities prompted you to apply CDIO?



PRIOR EXPERIENCE



TO WHAT DISCIPLINES IS CDIO APPLIED



AND TO ….

- Systems engineering
- Architectural engineering
- Business engineering
- Food technology
- Process engineering (2)
- Health Technology (2)
- Environmental Engineering (3)
- Materials sciences and technology

- Biomedical engineering
- Energy engineering (2)
- Industrial design engineering (4)
- Mining, Extraction Metallurgy, Physical Metallurgy
- Industrial Automation and Control Systems
- Multimedia & infocomm technology
- Nanotechnology & materials science
- Textile engineering

- Ca 10 programmes with specific names were difficult to classify, will check again

PROGRESS OF CDIO STANDARDS FULFILLMENT

Standard		Initial (average)	Current (average)
1	CDIO Context	1.7	3.6
2	CDIO Learning outcomes	1.8	3.8
3	Integrated curriculum	1.6	3.4
4	Introduction to engineering	1.9	3.8
5	Design-implement experiences	2.1	3.9
6	Engineering workspaces	1.9	3.3
7	Integrated learning experiences	1.7	3.3
8	Active learning	1.6	3.6
9	Enhancement of faculty engineering competence	1.3	2.9
10	Enhancement of faculty teaching competence	1.7	2.9
11	CDIO skills learning assessment	1.6	3.0
12	Program evaluation	1.2	2.7

DISCUSSION

- Considered as averages, the universities have made progress across the full range of CDIO standards, ie CDIO seems to by the survey responsees be adapted as a whole, not by cherry-picking

- Highest values for standards 2, 4 and 5 (easiest or most important?)

- Lowest values for standards 9, 10 and 11 (most difficult or least important?)

- Standard 5 has the highest starting point, perhaps indicates why schools initially became interested in CDIO

EFFECTS ON EDUCATION INPUT, RESOURCES, AND OUTPUT

EFFECTS ON EDUCATION INPUT, RESOURCES, AND OUTPUT (1 of 3)

POSITIVE (> 6.5)

Totally disagree = 1; Neutral = 5; Totally agree =10

Standard	1-10
Graduates have improved conceive-design-implement-operate skills	7.9
Graduates have improved interpersonal skills	7.8
We have received recognition for high quality in education (for example awards from government agencies)	7.5
We have increased collaboration with other universities for educational development	7.5
Graduates have improved personal skills	7.5
We have an increased number of published papers on educational development	7.2
Faculty teaching competence has improved	7.1
Quality of final degree reports/capstone design projects have improved	7.0
Alumni satisfaction has increased	6.9
Course satisfaction ratings have improved	6.9
Graduate employability has improved	6.6
Our graduates have received more awards (for example prizes for project or won student competitions)	6.6

EFFECTS ON EDUCATION INPUT, RESOURCES, AND OUTPUT (2 of 3)

NEUTRAL (3.5-6.5)

Standard	1-10
Faculty engineering professional competence has improved	6.5
Student recruitment has improved	6.4
Student retention has improved	6.3
CDIO implementation required significant investments in education infrastructure	6.2
More alumni are starting new companies	5.8
Graduates entry salaries are higher than for nearby universities who have not implemented CDIO	5.8
CDIO implementation has led to increased operating costs	5.5

Totally disagree = 1; Neutral = 5; Totally agree =10

EFFECTS ON EDUCATION INPUT, RESOURCES, AND OUTPUT (3 of 3)

TENDENCY TOWARDS DISAGREEMENT (< 4)

Standard	1-10
Graduates have less knowledge of math and science	3.4

Totally disagree = 1; Neutral = 5; Totally agree =10

DISCUSSION

- Strong agreement for CDIO aimed effects
  - CDIO, interpersonal, personal skills
  - Outside world seems to notice and appreciate cdio schools
  - Collaboration with other schools increasing

- Neutral views on recruitment, retention, higher pay for graduates

- Neutral or disagreement of some “fears” of cdio, ie increasing costs and lowered disciplinary knowledge

- Statements related to alumni tend to have a high fraction “cannot assess” etc

BARRIERS AND SUCCESS FACTORS

BARRIERS AND SUCCESS FACTORS (1 of 2)

POSITIVE (> 6.5)

Standard	1-10
CDIO is well aligned with the vision and strategy of our department/ university	8.9
University management strongly supported our CDIO implementation	8.1
The CDIO implementation was associated with higher ambitions for our education	8.1
We had clear visions and goals for what we wanted to achieve by the CDIO implementation	7.9
CDIO implementation has supported accreditation	7.9
It was easy to customize the CDIO framework to fit our local context	7.3
If the main CDIO proponent at your university was to retire tomorrow, the changes that have been made to date would remain five years from now	7.2
CDIO has created attention for education in our university	7.2
We had sufficient financial resources to implement CDIO	6.6

Totally disagree = 1; Neutral = 5; Totally agree =10

BARRIERS AND SUCCESS FACTORS (2 of 2)

NEUTRAL (3.5-6.5)

Standard	1-10
Faculty were incentivized and recognized for CDIO implementation efforts	5.8
We measured the impact of our CDIO implementation with suitable indicators	5.7
Faculty teaching competence was a barrier to CDIO implementation	5.2
Faculty were resistant to CDIO	4.9
Faculty engineering professional competence was a barrier to CDIO implementation	4.9

Totally disagree = 1; Neutral = 5; Totally agree =10

OBSERVATIONS

- Strong agreement for
  - CDIO resonates with university strategies and seems well-supported by university management
  - Higher ambitions and attention for education
  - Support for accreditation

- Neutral on use of incentives, measurable indicators
- Faculty resistance and professional competence is also neutrally ranked, and relatively distant from agreement

- No disagreements wrt barriers and success factors, ie most seemed to have succeeded (survey bias, honest answers?)

FREE TEXT QUESTIONS

WHAT DEVELOPMENT OR CHANGE NEEDS DO YOU SEE FOR THE CDIO FRAMEWORK?

"If CDIO wants to give direction to the development of engineering education, it should adoption and disseminate innovative ideas and concepts , for instance about the role of online education, virtual or remote labs. CDIO cannot afford to stand still."

"CDIO should develop a clear vision on what knowledge and skills the engineer of the future (2030) will need. What is the estimated main differences from the engineer of today and initiate a discussion on how we should adapt the CDIO framework in order to meet these new demands."

"Revision of rubrics for evaluation of CDIO standards"

"Recommendations for how to gather evidence of effects at different levels (ex. through workshops at CDIO conferences)"

"To develop and specify the CDIO Standards and Syllabus for Master and PhD Programmes". "There remains professional graduate Masters training that could be developed (design and professionalism). "

"A step-by-step how-to-implement book." "More guidance on teaching professional skills in the program (best practice examples) as this remains far from the skills sets of most professors". "Implementation guide will be useful for universities in early phases of approach".

"More personal factors such as intrinsic motivation to be more explicitly mentioned".

"More attention to gender and sexual diversity"

"It would be nice to provide some kind of a certificate or proof of compliance from CDIO organization."

"None."

WHAT DEVELOPMENT OR CHANGE NEEDS DO SEE FOR THE CDIO INITIATIVE (THE NETWORK OF UNIVERSITIES THAT DEVELOPS THE CDIO FRAMEWORK)

"Liaise more closely with other professional engineering education associations (ASEE, CEEA, SEFI, AAEE, IEEE, ASME)." "Explore the possibility of having tighter integration with the Deans from the respective regions."

"More marketing to improve credibility." "An International Journal of CDIO"

"Support student mobility." "Joint student projects."

"Support mobility of faculty. Explore Erasmus+"

"Change international meeting schedule so that there is at least 1 big meeting in each of 3 regions (Americas, Europe, Australasia) each year."

"Maybe a reconsideration of the need for the Fall meeting."

"Enhanced focus on outcomes for experienced members."

"We would like CDIO to be a quality network, in which all members support and learn from each other. I prefer for instance to have probationary members who have interesting and ambitious plans but are still on level 0 of CDIO adoption. If successful, probationery members can be raised to proper membership"

"I would like to see the organization shift into more of a sharing and how-to mode. Focus on practice of engineering rather than scholarship"

"Maybe the regions have to be revised given the growth of parts of them and the low implantation in other parts."

CONCLUSIONS AND FUTURE WORK

- The CDIO survey aimed to investigate the use of CDIO, its benefits, barriers/success factors to/for implementation.
- About 40 % of CDIO Initiative member completed survey
- Most common CDIO programs are ME, EE, CS but also IE, CE and ChemE are implementing CDIO at more than 25 % of CDIO schools
- Most common motives for CDIO: need for authenticity, methodology, design & innovation
- Most CDIO implementations seems to be successfully achieving the aims of CDIO
- Few strong barriers are reported (by the survey respondents)
- Further analysis will be conducted, e.g., based on groupings
- Paper for 2015 international CDIO conference, Chengdu, China

Thank you for listening!

(And to those of you who completed the long survey,
thank you so much for your effort!)