THE "GENERATION CS" UNDERGRADUATE ENROLLMENT SURGE

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CS Education Summit, Pittsburgh, PA

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ORGANIZATION

Highlights from the CRA Generation CS report

Data updates since the Generation CS survey was conducted

Some follow up activities currently under way

CS versus other areas of computing

HE GENERATION CS REPORT – KEY OBJECTIVES AND PUBLICATION

Document the extent of the current enrollment surge in CS

- At different types of academic units (doctoral-granting vs non-doctoral-granting, public private, large vs small)
- Among different types of students (majors vs non-majors, men vs women, majority vs minority)
- At different points in the curriculum (intro, mid-level, upper-level)

Understand how units are coping with the surge (policies and resources)

Authors are “Institution” subgroup of ad hoc CRA Enrollments Committee

Three ACM Inroads articles spun off from main report (June, September, December 2017)

CRA ENROLLMENT COMMITTEE: INSTITUTION SUBGROUP

Tracy Camp, Chair, Colorado School of Mines

W. Richards Adrion, University of Massachusetts Amherst

Betsy Bizot, CRA

Susan Davidson, University of Pennsylvania

Mary Hall, University of Utah

Susanne Hambrusch, Purdue University

Ellen Walker, Hiram College

Stuart Zweben, The Ohio State University

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THE DATA

From key annual sources

- CRA Taulbee Survey (doctoral-granting units)
- ACM NDC Study (non-doctoral-granting units – only 3 yrs history as of CRA study)
- IPEDS (CS degree production data only)

Customized survey

- Conducted fall 2015 – winter 2016
- Academic units with CS undergrad programs as identified through Taulbee and NDC
- Used same data entry platform as Taulbee and NDC
- 134 respondents from Taulbee units; 93 from NDC units; not all units responded to all questions

HIGHLIGHTS OF FINDINGS – GROWTH OF CS MAJORS

ctoral-granting units

- Average number of CS majors has more than tripled since academic year 2006-07.
- Now at more than 1.5 times peak average during dot-com boom.
- Similar growth at public and private, and at large and small units.
- Similar percentage growth in majors enrollment in courses at all levels of curriculum.

n-doctoral-granting units

- Insufficient historical data to do many similar analyses.
- Growth appears substantial, but not as high as at doctoral-granting, based on IPEDS degree production data and course enrollment by majors at different points in curriculu

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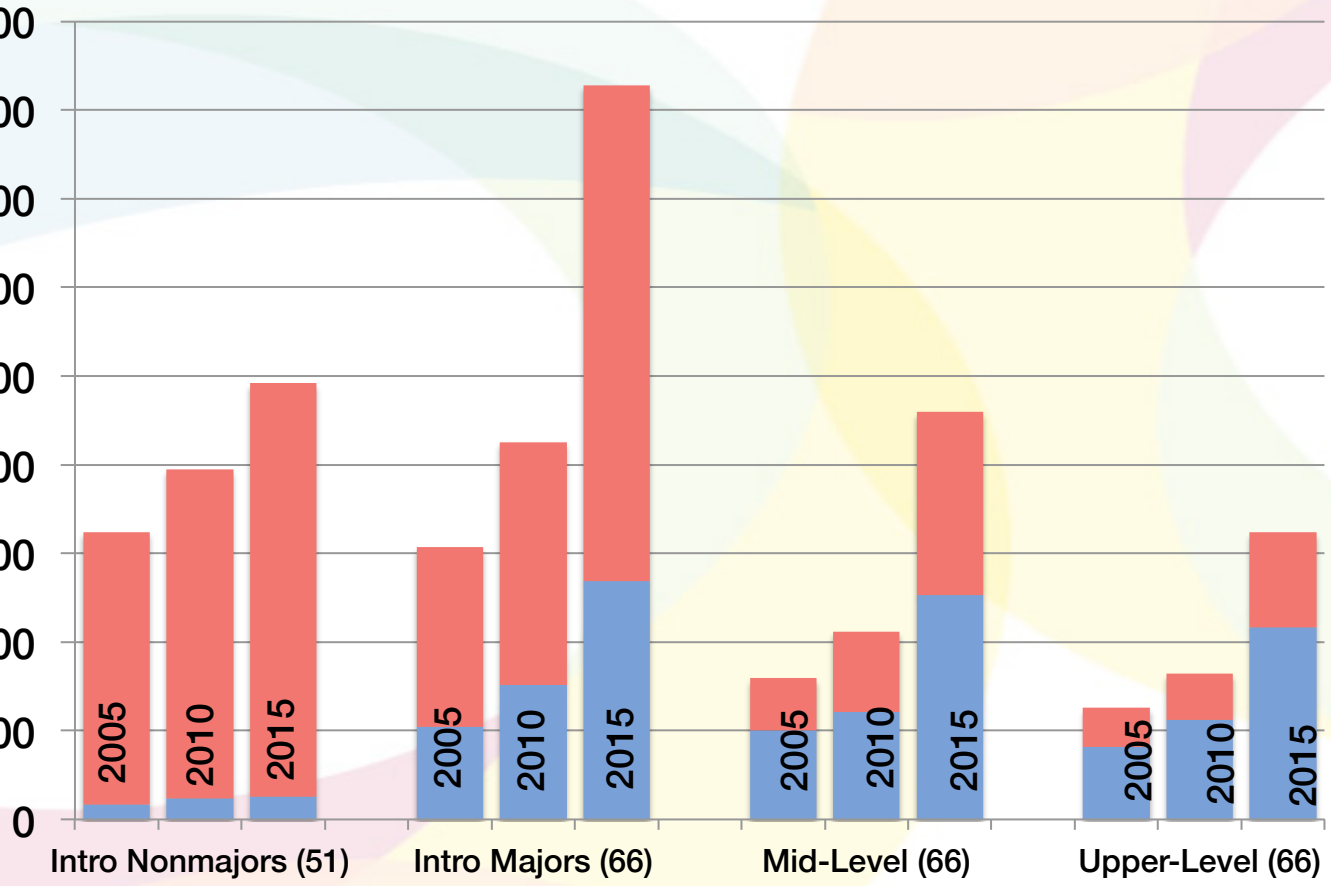
HIGHLIGHTS OF FINDINGS – GROWTH IN NON-MAJOR ENROLLMENT

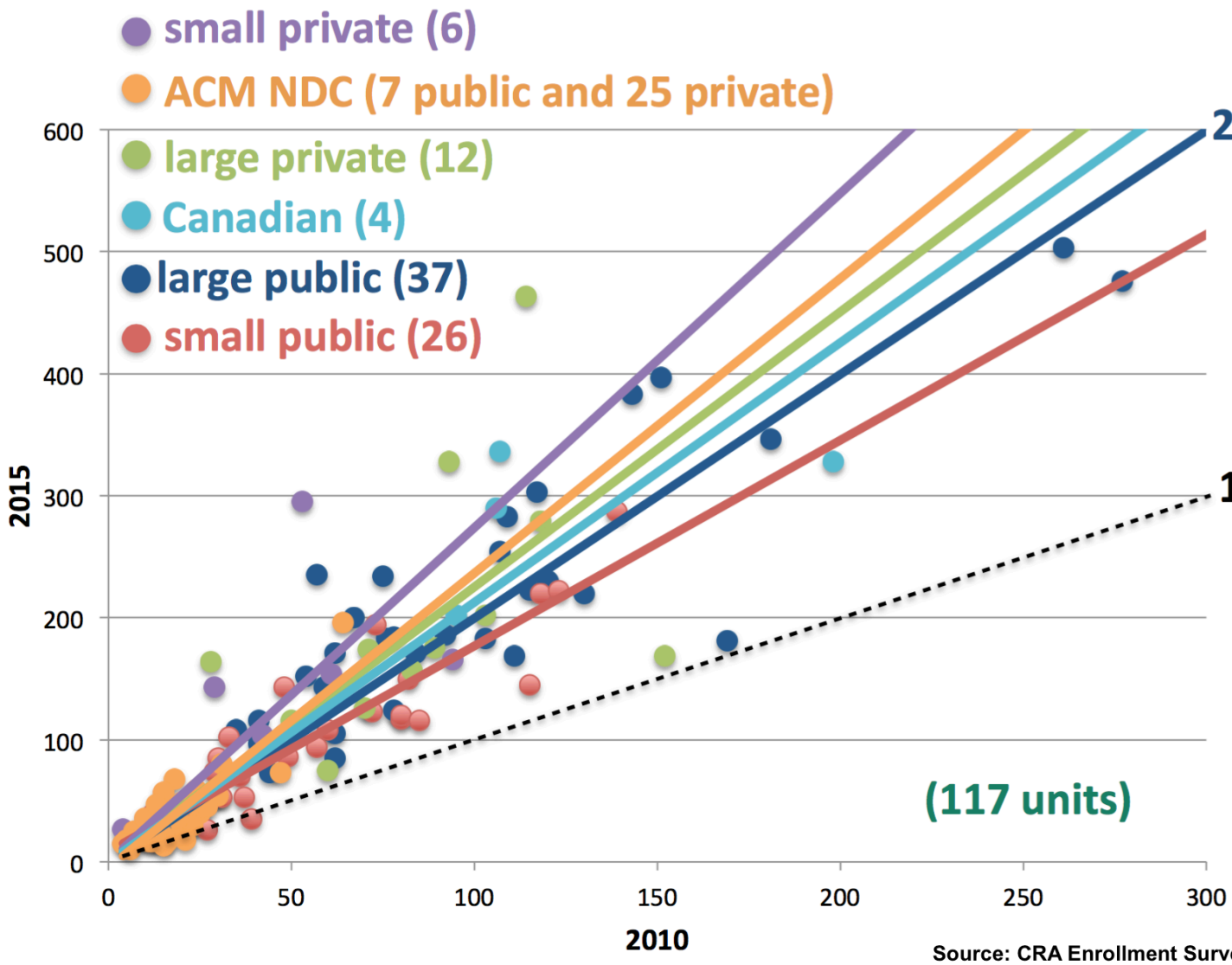


Source: CRA Enrollment Survey

Since 2005-06 percentage enrollment increases by n majors is at lea comparable to increases by majors, in representative courses. (Total enrollment for departments w data all 3 years

ENROLLMENT NCREASES IN MID-LEVEL COURSE: 2010 VS. 2015

ACH DOT EQUALS ONE INSTITUTION



HIGHLIGHTS OF FINDINGS – IMPACT ON DIVERSITY

- Percentage of women & URMs enrolled in CS courses at all levels of curriculum increa between 2005 and 2015.
- Increased gender diversity, but not ethnic diversity, also apparent in recent IPEDS deg production data.
- Decreased percent of degrees to African-Americans and increased percent to Hispanic Latinos in last few years.
- Higher representation of women in non-doctoral-granting units than in doctoral-granting (roughly 5-7% difference at each level of the curriculum in 2015).
- Higher representation of women & URMs at private than at public.

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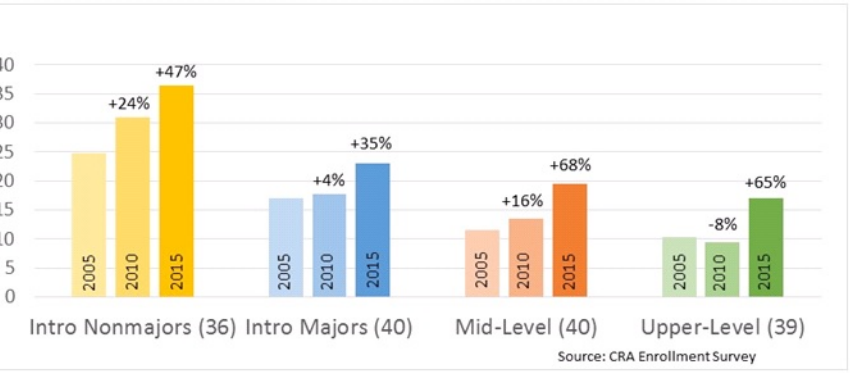
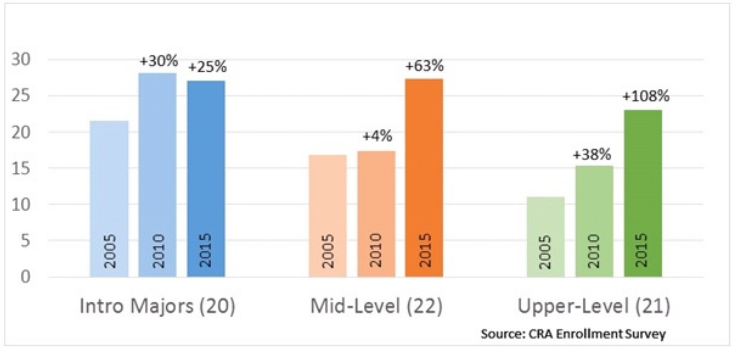
EDIAN PERCENT OF WOMEN IN COURSES AT EACH LEVEL

ctoral Institutions



Non-doctoral Institutions



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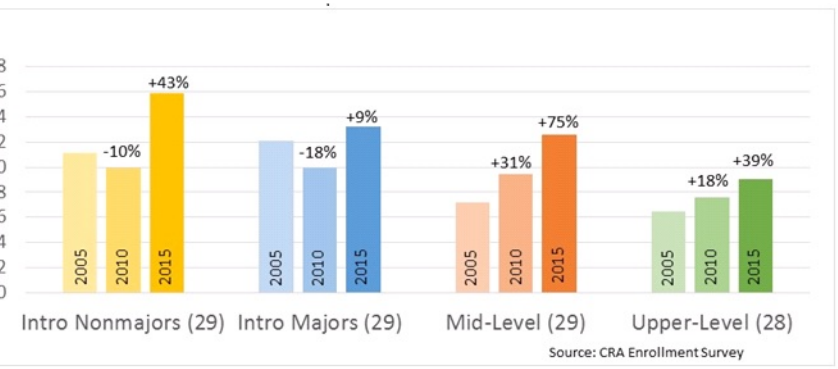
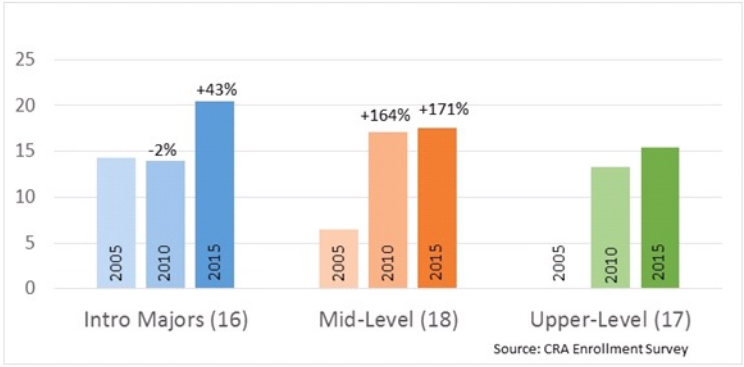
EDIAN PERCENT URM AT EACH LEVEL (NON-MSI INSTITUTIONS)

ctoral Institutions



Non-doctoral Institutions



HIGHLIGHTS OF FINDINGS – WHAT CONCERNS THE UNITS?

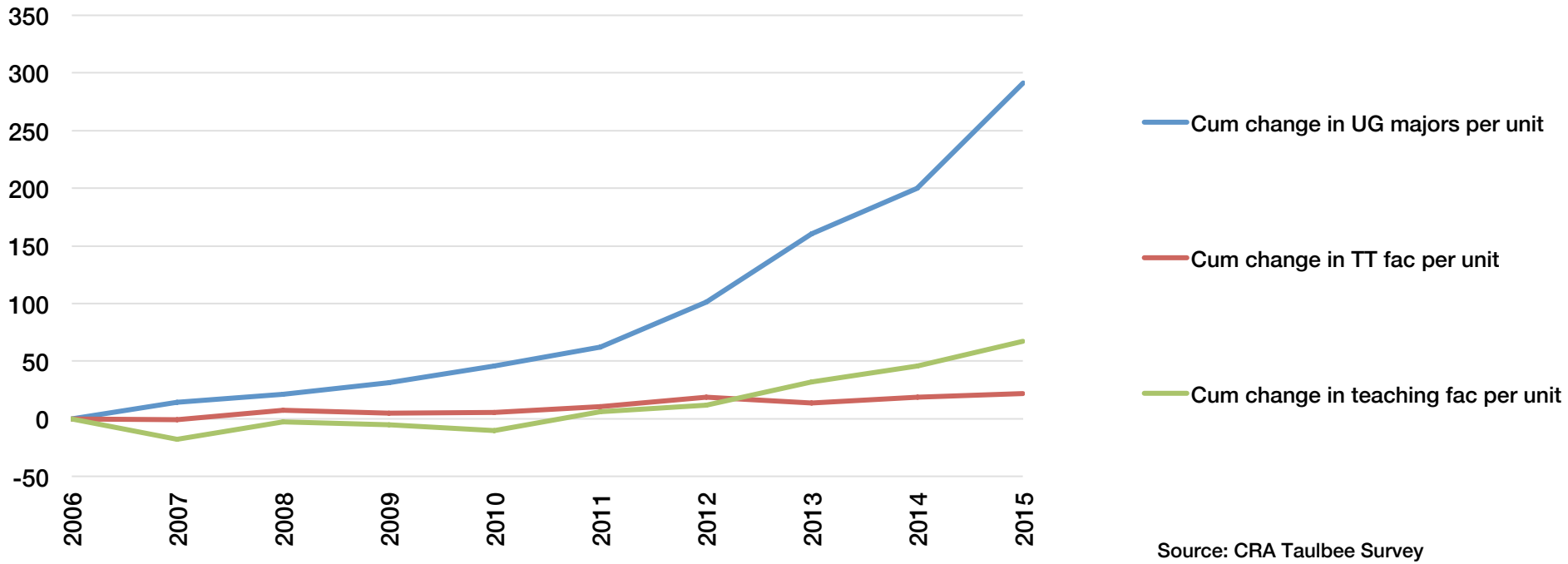
Shortage of teaching resources

Shortage of physical space

Faculty workload demands

Impacts on students

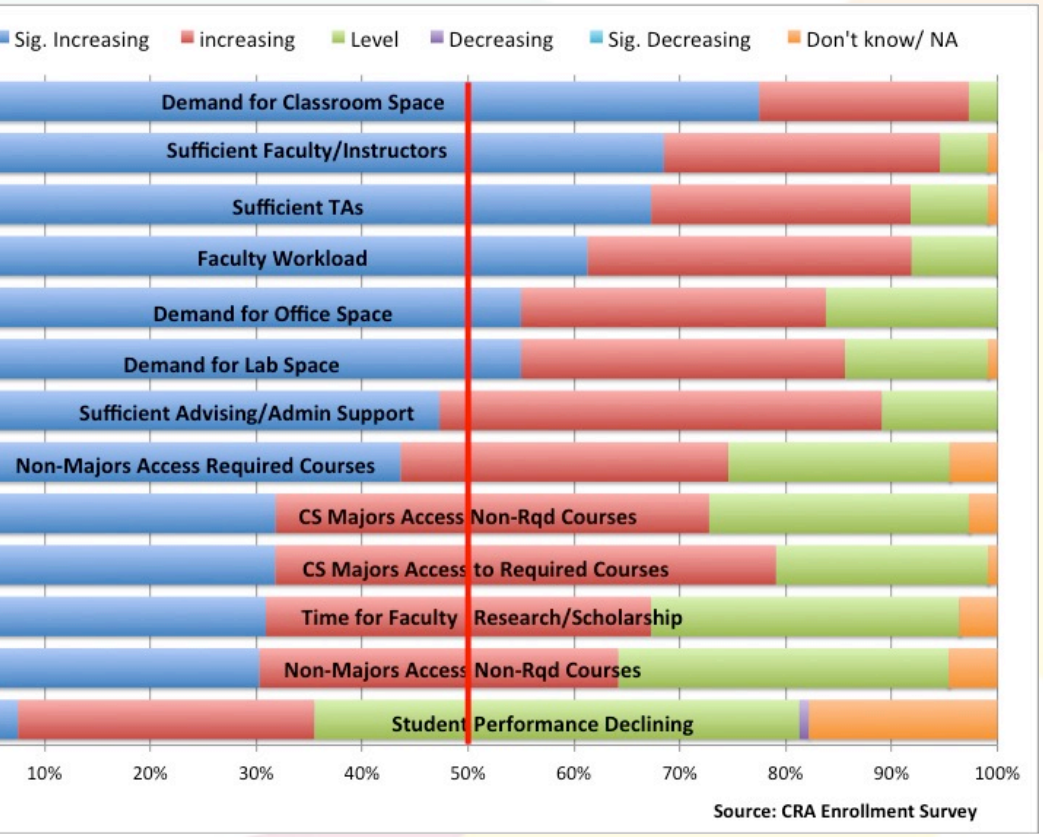
HERE ARE THE PRESSURE POINTS?
EACHING RESOURCES COMPARED TO MAJORS



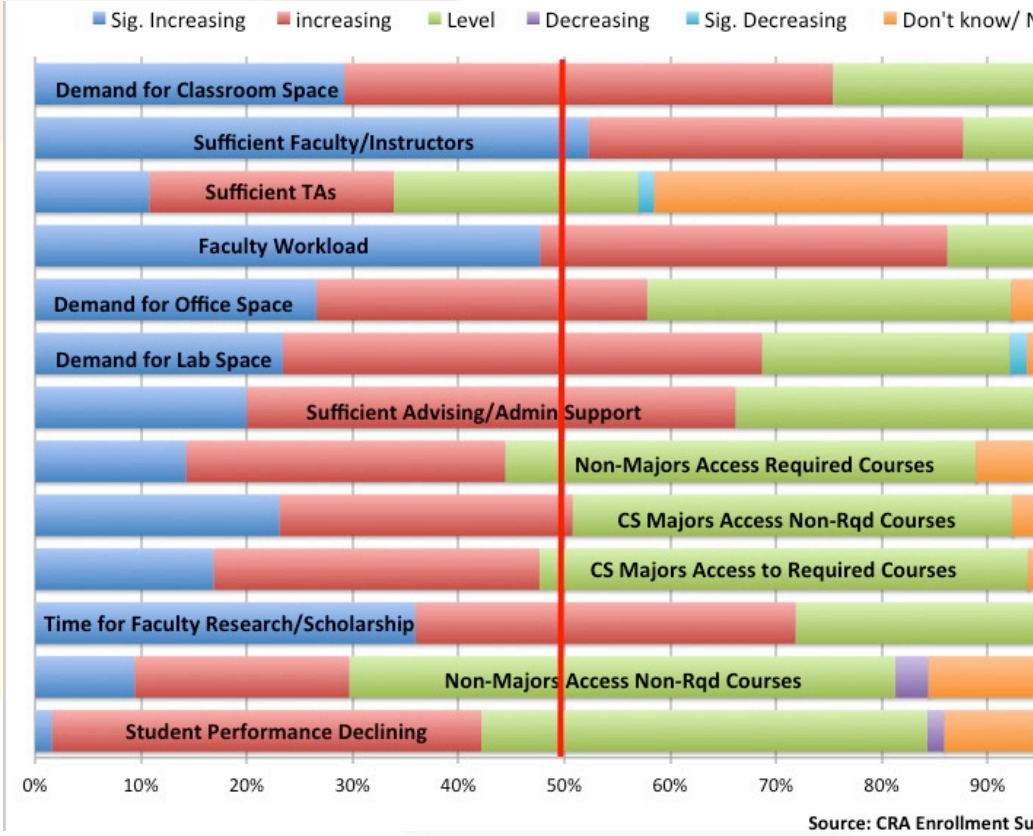
Source: CRA Taulbee Survey

HERE ARE THE PRESSURE POINTS?
NIT CONCERNS

ctoral Institutions



Non-doctoral Institutions



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HIGHLIGHTS OF FINDINGS – HOW ARE UNITS COPING? MOST COMMON ACTIONS

Nearly all doctoral-granting units

- Significantly increased class sizes (1/2 NDC)
- Increased the number of sections of required courses (2/3 NDC)

Most added undergrad TAs, adjuncts, graduate TAs, and teaching faculty (NDC very differ but ~1/2 added adjuncts and 20% added teaching faculty)

About half

- restricted upper level courses to majors and minors (15% NDC)
- limited enrollments in high demand courses
- advise less successful students to other majors (1/3 NDC)
- reduced small-enrollment courses and electives (1/3 NDC)
- Increased T-T faculty (1/4 NDC)
- Reduce contributions outside of unit (NDC only)

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OW ARE UNITS COPING, CONTINUED. LESS COMMON ACTIONS.

About ¼ tightened the requirements for the major; another 14% considering/planning (<10
NDC)

- Note: anecdotally, this was more common during dot-com boom, but likely had a negat
  effect on diversity

About 20%

- Increased teaching loads (1/4 NDC)
- Increased on-line courses (< 10% NDC)

Hardly anyone

- Changed capability of faculty to “buy out” of course assignments
- Spun off service courses to others
- Raised the bar for doing well in a course

2016 TAULBEE AND NDC SURVEY DATA

Continued increased enrollments at all levels vs 2015 (Taulbee)

- ~7% intro level
- ~20% mid-level (~35% in non-majors!)
- ~10% upper-level (~9% in non-majors)

Increased representation of women (Taulbee)

- 18.3% of total CS enrollment in 2016 vs 16.5% in 2015

Increased percentage of CS degrees to women

- NDC: 22.1% in 2016 vs 17.4% in 2015
- Taulbee: 17.9% in 2016 vs 15.7% in 2015

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TEACHING FACULTY

Teaching faculty are part of the enrollment surge response for many institutions but we do know much about the landscape

From 2011 to 2016, median teaching faculty at Taulbee institutions increased from 3 to 6

Taulbee 2016 asked about titles for full-time teaching faculty

- 70% use lecturer in title (41% with multiple levels, 30% with single level)
- Half use a title including “professor” (clinical, instructional, professor of the practice, etc 17% with single level and the rest with multiple levels of assistant-associate or assistan associate-full
- 18% use instructor (10% single level, 8% multiple levels)

CRA Teaching Faculty Committee

- Best practices for management of teaching faculty
- Surveys to understand these titles better, including qualifications, duties, other terms o employment (from both academic units and teaching faculty themselves)
- Survey results will drive future data collection by Taulbee Survey

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RETENTION

Historically of concern in CS, especially w.r. to diversity

Diversity data from course enrollments suggests looking more deeply into t

Significant published data hard to come by; complicated by

- Differences in how & when majors are declared
- Lack of information about intentions of students at “starting point”
- Ideally following individuals, not just total numbers

ACM Ed Council Task Force chaired by Alison Miller (Oracle) and Chris Stephenson (Google)

- Studying NCWIT data from Pacesetters and Extension Services

ASEE – cohorts from colleges of engineering, but not distinguished by program area

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DATA BUDDIES

- Taulbee and IPEDS data give us numbers for what happened, but don't directly tell us why
- Data Buddies, a project of CRA's Center for Evaluating the Research Pipeline (CERP), asks individual students about their motivations and experiences
- National survey data is collected from undergraduate and graduate students at participating departments, currently more than 100 doctoral and non-doctoral institutions
- Survey items include past experiences, knowledge and confidence, sense of belonging, perceptions of one's department, persistence in computing
- Departments get a report comparing the responses of their students to those in similar departments
- Provides a way to benchmark data for an intervention against similar students not taking p

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USING IPEDS DEGREE DATA RELATIVE TO COMPUTER SCIENCE

ree ways to identify computing-related degrees from the IPEDS data on all grees

Academic Discipline, Broad (“Math and Computer Sciences”)

Academic Discipline, Detailed (“Computer Science”) – commonly used but little misleading

Classification of Instructional Programs (CIP) Codes

- Distinguish different programs in all areas of study for federal reporting
- Categorized under more than 50 major headings
- Have four digit numbers following each major heading (i.e., xx.yyyy)
- Change slowly. (Last updated in 2010. No “data science” CIP.)

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COMPUTING CIP CODES

ny computing CIPs are found in major heading 11 (Computer and Information Sciences ar
pport Services)

- This frequently is used as a synonym for “computer science” (e.g., in Nager and Atkins article) but that’s not precise, and can distort results (about total degrees, diversity)
- All 11.yyyy CIP Codes are some type of computing, but include not only CS, but also I Information Science, Systems Analysis, Security, et al.
- NSF “Detailed Discipline” of Computer Science includes most but not all 11.yyyy
- Areas such as computer engineering, software engineering, and MIS are not in 11.yyy
- Many interdisciplinary areas such as Informatics and X+CS degrees are not in 11.yyyy
- Codes 11.0101 and 11.0701 are typically used by CS programs, narrowly defined

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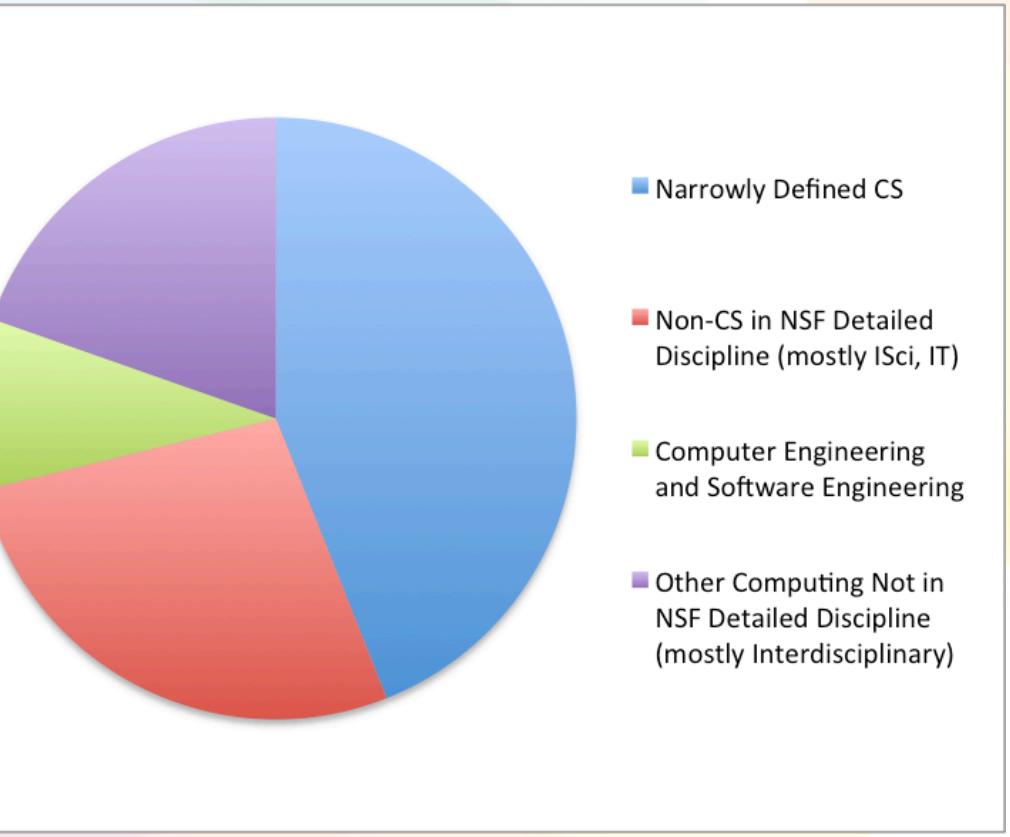
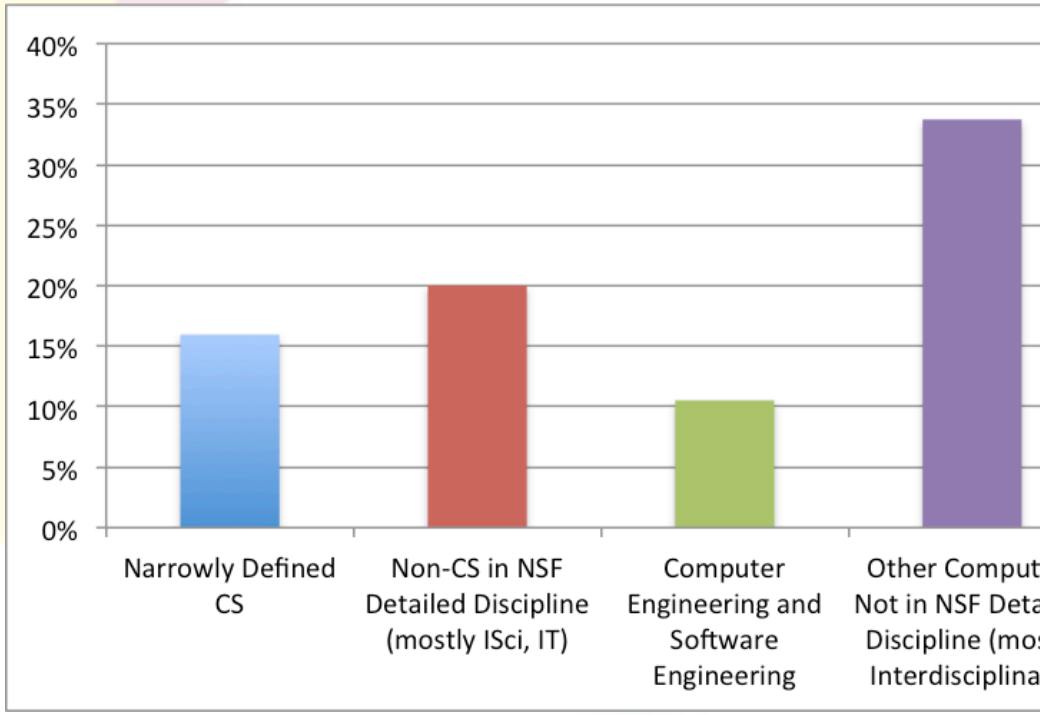
OMPUTER SCIENCE VS. COMPUTING AS A WHOLE IN IPEDS DATA

mputing Bachelor's Degrees in 2015



Why does this matter? Compare apples to apple
For example, % female in 2015.



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